FUEL AND FUEL ADDITIVE REGISTRATION TESTING FOR KIOR (KiOR RENEWABLE DIESEL BLENDSTOCK 5)

FINAL REPORT
(Revised)

SwRI® Project No. 03.16085

Prepared for:

KiOR, Inc.
13001 Bay Park Road
Pasadena, TX 77507

Prepared by:

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Martin J. Heimrich, Principal Engineer
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Southwest Research Institute®
6220 Culebra Rd.
San Antonio, TX 78238

January 25, 2012

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IDENTIFICATION OF TEST SUBSTANCE

KiOR Renewable Diesel Blendstock 5 which was prepared by blending 5 percent by volume of a KiOR Distillate with 95 percent diesel fuel

MANUFACTURER

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FOREWORD

This project was performed for KiOR, Inc. under SwRI Project 03.16085. Mr. Roger L. Leisenring, Jr. was the program director for KiOR, Inc. The Principal Investigator for Southwest Research Institute (SwRI) was Mr. Martin J. Heimrich, Principal Engineer; and the Project Leader was Mr. E. Robert Fanick, Manager of the Emissions Chemistry Section in the Emissions Research and Development Department. SwRI technical personnel involved in heavy-duty engine operation and emissions testing included: Mr. Matthew A. Marshall, Mr. Richard C. Mendez, Ms. Svitlana Kroll, Ms. Yolanda Rodriguez, Mr. Chuan-yi (Joe) Tsai, Ms. Janelle N. Sancho, and Ms. Kelley L. Strate. Data reduction was performed by Ms. Linda M. De Salme, Ms. Kathleen M. Jack, and Mr. Kenneth T. Miltenberger. Southwest Research Institute is located at:

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TEST SUBSTANCE INFORMATION

KiOR, Inc. has developed a proprietary technology platform to convert low-cost, abundant, and sustainable non-food biomass into hydrocarbon-based oil. The conversion process yields a renewable crude oil, which is then upgraded into gasoline and diesel blendstocks, using standard refinery equipment. A scheme of this process is sketched in Figure TSI-1. Gasoline and diesel blendstocks produced from their proprietary biomass fluid catalytic cracking (BFCC) process are projected to reduce direct lifecycle greenhouse gas emissions by over 80 percent compared to the petroleum-based fuels they displace.

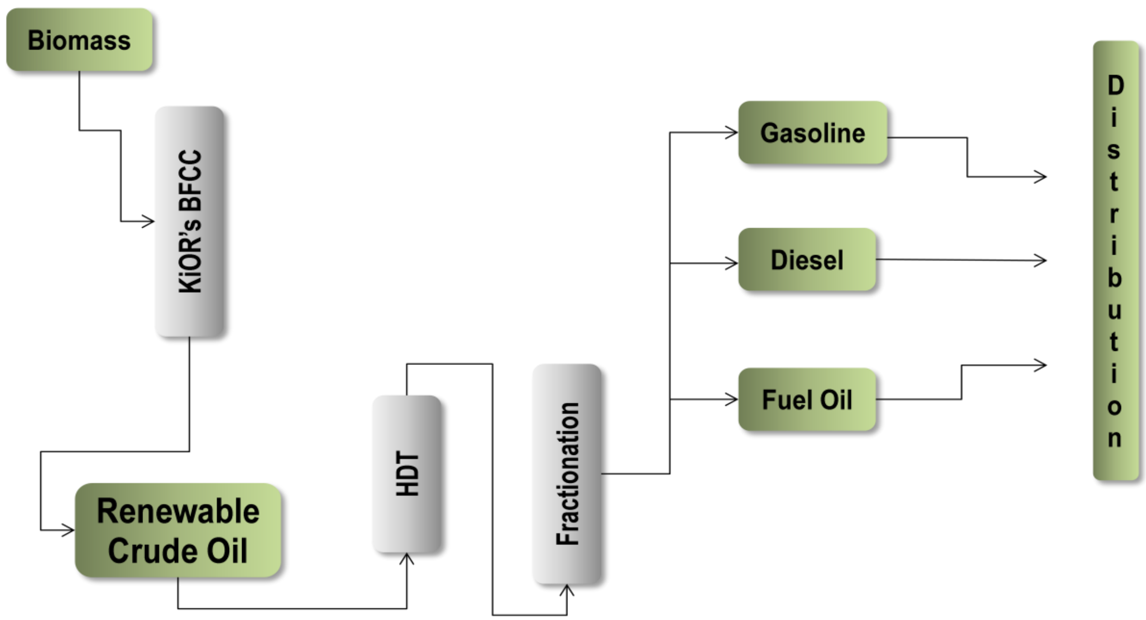


FIGURE TSI-1. KiOR INC.'S CURRENT OPTION FOR FUELS MANUFACTURING

After extensive hydrodeoxygenation, KiOR Inc.'s Renewable Crude oil yields hydrocarbon fuels with approximately 87.5 weight percent carbon, approximately 12.3 weight percent hydrogen, approximately 0.2 weight percent nitrogen, and very low levels (ppm) of oxygen. Other elements are present at parts per billion levels or below detection limits, using ASTM D7111 for trace elements. The composition of the Renewable Crude oil is adjusted by fractionation to form a KiOR Distillate. Initial boiling point is in the range of about 160°C (320ºF), and the final boiling point is 370°C (698ºF). The KiOR Distillate is then blended with diesel fuel at a concentration of 5 volume percent to form a fuel called KiOR's Renewable Diesel Blendstock 5.

EXECUTIVE SUMMARY

A renewable diesel fuel blendstock was evaluated for KiOR, Inc. to address Environmental Protection Agency (EPA) requirements for registration of designated fuels and fuel additives (F/FA) as stipulated by sections 211(b) and 211(e) of the Clean Air Act (CAA). Under the Tier I requirements of this protocol, manufacturers of F/FAs are required to supply EPA with:

- The identity and concentration of emission products from the F/FA
- An analysis of potential emissions exposures
- Any available information regarding the health and welfare effects of the whole and speciated emissions.

As a result, emission generation, collection, and analysis of the regulated emissions and of selected vapor- and particulate-phase unregulated emissions, and a speciation of volatile-phase hydrocarbon compounds were performed on a 2011 6.7L Ford Diesel engine equipped with aftertreatment (diesel oxidation catalyst, diesel particulate filter, and a selective catalytic reduction catalyst). The engine was emissions tested after 125 hours of engine operation with the base fuel. Testing involved a cold- and hot-start test sequence on each of three different days with the aftertreatment installed and once again with the aftertreatment removed. Samples were collected and analyzed for regulated emissions including: non-methane hydrocarbons (NMHC), carbon monoxide (CO), oxides of nitrogen (NO_x), and total particulate; for a hydrocarbon speciation of volatile hydrocarbons; and for volatile- and particulate-phase polycyclic aromatic hydrocarbons (PAH) and nitrated polycyclic aromatic hydrocarbons (NPAH). The fuel was then changed to a blend of five volume percent (5%) KiOR Distillate and 95 volume percent base diesel to form a product called KiOR Renewable Diesel Blendstock 5. This fuel blend is designated in this report as "Fuel RDB5". The engine was operated for 125 hours with Fuel RDB5. At the completion of the durability engine operation, the above emission characterization test sequence was repeated.

In general, the engine was able to meet the 2011 emissions standard with Fuel RDB5 with aftertreatment. In this case, the composite emissions with the aftertreatment were 0.06 g/bhp-hr for NO_x, 0.002 g/bhp-hr for NMHC, 0.5 g/bhp-hr for CO, and 0.000 g/bhp-hr for particulate. With aftertreatment, all regulated emissions with Fuel RDB5 were at the level comparable with emissions with base fuel. NMHC emissions were lower by 0.006 g/bhp-hr with Fuel RDB5 (0.002 g/bhp-hr) than with base fuel (0.008 g/bhp-hr). NO_x emissions were slightly higher with Fuel RDB5 (0.06 g/bhp-hr) than with base fuel (0.05 g/bhp-hr); however, the NO_x level was sufficiently lower than the emission standard (0.20 g/bhp-hr). CO emissions and particulates were at the same level for both fuels. With the aftertreatment removed, the emissions were 0.72 g/bhp-hr for NO_x, 0.129 g/bhp-hr for NMHC, 3.6 g/bhp-hr for CO, and 0.322 g/bhp-hr for particulate. Without aftertreatment, emission levels were similar for the candidate blend and the base fuel. A higher level of emissions without aftertreatment was expected because the aftertreatment was necessary for the engine to meet current emissions standards.

When the speciated emissions using RDB5 were compared to the emissions using base fuel (with engine exhaust aftertreatment), no additional C_1 to C_{12} hydrocarbons, aldehydes, or ketones were present in the exhaust at or above the detection limits of the analytical procedures. In addition, a number of compounds were detected in the tests without aftertreatment that were not detected in the tests with aftertreatment. Concentrations were also lower with aftertreatment than without. Generally, speciated emissions profiles were substantially similar for both the base fuel and RDB5.

The measurement of volatile- and particulate-phase PAH and NPAH were required in this study. Analyses were conducted for individual compounds including: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, 7-nitrobenzo[a]anthracene, 6-nitrobenzo[a]pyrene, 6-nitrochrysene, 2-nitrofluorene, and 1-nitropyrene. In general, the concentrations of PAH and NPAH were lower with aftertreatment than without it, and the PAHs were generally higher in concentration than the NPAHs. In addition, the concentrations of PAH and NPAH in the volatile-phase were lower than the concentrations of the PAH and NPAH in the particulate-phase. No additional PAH or NPAH were found with RDB5.

1.0 INTRODUCTION

This work was performed for KiOR, Inc. to address Environmental Protection Agency (EPA) requirements for registration of designated fuels and fuel additives (F/FA) as stipulated by sections 211(b) and 211(e) of the Clean Air Act (CAA). In general, standard mandatory requirements for F/FA registrations are contained in a three tiered structure. The first two tiers generally apply to most F/FA manufacturers, but there are special provisions for certain types of additives and for small businesses. Each manufacturer is required to submit basic registration data for each product being registered. Small businesses with less than $50 million of annual sales are excused from the first two tiers of requirements for F/FA which are considered baseline or non-baseline, and small businesses with less than $10 million annual sales are excused from Tier 2 requirements for “atypical” F/FA. Definitions of baseline, non-baseline, and “atypical” F/FA are discussed in detail below. Other special provisions include experimental F/FA, relabeled products, and products exclusively for off-road use.

Each F/FA is sorted into one of two broad "fuel families": conventional or alternative. The conventional fuel families are gasoline and diesel, and the alternative fuel families include methanol, ethanol, methane, and propane. Each fuel family is then subdivided into three "F/FA categories": baseline, non-baseline, and “atypical.” The baseline category consists of fuels and associated fuel additives which resemble the respective baseline fuel for a particular fuel family in terms of elemental composition (no elements other than carbon, hydrogen, oxygen, nitrogen, and sulfur), and which conforms with certain quantitative limits for particular constituents. "Atypical" is defined as those fuels which contain metals; elements other than carbon, hydrogen, nitrogen, sulfur, and oxygen or do not meet the requirements under ASTM D975 “Standard Specifications for Diesel Fuel Oils.” The non-baseline category is an intermediate category between baseline and atypical. In the diesel fuel family, the distinction between baseline and non-baseline is based primarily on the presence of significant concentrations of oxygen-containing compounds (greater than 1.0 percent oxygen by weight).

Tier 1 testing for the generation, collection, and analysis of combustion emission samples was required. Regulated exhaust emissions for non-methane hydrocarbons (NMHC), carbon monoxide (CO), oxides of nitrogen (NO_x), and particulate (PM) and carbon dioxide (CO_2) were evaluated for all tests conducted. In addition, hydrocarbon speciation was performed to determine volatile-phase exhaust hydrocarbons, aldehydes, and ketones; and samples were collected for volatile- and particulate-phase polycyclic aromatic hydrocarbons (PAH) and nitrated polycyclic aromatic hydrocarbons (NPAH). This report includes the emission measurements that were conducted as part of the requirements for the registration of an additive or fuel as stipulated by sections 211(b) and 211(e) of the CAA.

2.0 HEAVY-DUTY ENGINE TESTING

2.1 Objective

The objective of this program was to provide KiOR Inc. with the generation, collection, and analysis of combustion emission samples from a 5 volume percent blend of KiOR Distillate blendstock with 95 volume percent petroleum diesel (blended fuel designated as “Fuel RDB5” in this report) using a 2011 6.7L Ford Diesel engine. Emission testing was conducted according to Tier 1 requirements as identified in Title 40 CFR Part 79, Subpart F, Section 79.57. Protocols outlined in Title 40 CFR Part 86, Subpart N and in applicable Southwest Research Institute® (SwRI)® Test and Inspection Procedures (TIP) References 1 through 17 were followed.

2.2 Scope of Work

2.2.1 Heavy-Duty Test Protocol

Tier 1 testing for fuel and fuel additive registration requires the EPA transient test protocol. Prior to testing, the engine was operated for 125 hours to “break-in” the engine. Emission testing was then performed on the engine at the 125-hour point with the base fuel. Testing consisted of cold- and hot-start EPA transient sequences with one cold- and one hot-start test performed each day. Three test sequences were performed with the diesel oxidation catalyst/diesel particulate filter/selective reduction catalyst (DOC/DPF/SCR) in place, and three test sequences were performed with the aftertreatment removed (a spool piece was installed in place of the DOC/DPF/SCR). At the completion of the baseline testing, the fuel was changed to Fuel RDB5. Durability engine operation was performed for an additional 125 hours of engine operation, and the emissions characterization test sequence with was repeated with Fuel RDB5. Table 1 presents the test plan for the fuel evaluations conducted in this study.

The EPA transient cycle or Federal Test Procedure (FTP) is described by means of percent of maximum torque and percent of rated speed for each one-second interval over a test cycle of 1199 seconds duration. To generate a transient cycle, an engine's full load torque curve is obtained from an engine speed below curb idle speed to maximum no-load engine speed. Data from this "torque curve," or torque map, are used with the specified speed and load percentages to form a transient cycle. A graphic presentation of the speed and torque commands which constitute a transient cycle is given in Figure 1 for illustration purposes. The first five minutes of the cycle is designated as the New York Non-Freeway (NYNF) portion of the test and represents city operation with extensive idle time. The second five minutes is called the Los Angeles Non-Freeway (LANF) portion. This part of the test also represents city operation, but without the excessive idle time. The third five minute section of the test is called the Los Angeles Freeway (LAF) portion. This part is more representative of higher speed conditions indicative of freeway operation. The final five minutes of the EPA transient cycle is a repeat of the NYNF portion. These four parts are combined to give the EPA transient cycle.

TABLE 1. TEST PLAN FOR HEAVY-DUTY TESTING

STEP	DESCRIPTION
1	Perform emission instrument calibrations as required. Calibrate torque meter and check signal conditioning systems. Validate Constant Volume Sampler (CVS) gaseous and particulate sampling systems using propane recovery techniques.
2	Install engine in transient-capable test cell and check engine condition. Engine must be new with less than 12 hours of previous operation. Bring engine oil level to "full" using oil specified by the manufacturer.
3	Perform fuel change procedure to base diesel fuel (EM-8034-F). Change fuel filters, purge fuel supply, etc. (**Note:** No other fuel should be used until testing with this fuel has been completed.) Perform 125 hours of engine operation with the base diesel fuel. If unscheduled maintenance is necessary, the repairs will be made to Original Equipment Manufacturer (OEM) specifications using OEM or OEM approved parts. In addition, emissions should be measured after any unscheduled maintenance and before resuming durability, to ensure that post-maintenance emission levels are within ±20 percent of the pre-maintenance emission levels.
4	Repeat Step 1 as necessary. Operate engine at rated speed and full load for approximately 10 minutes, then power validate engine.
5	Conduct transient “full-throttle” torque map from low- to high-idle and save resulting transient command cycle.
6	Run a 20-minute practice EPA transient cycle without engine-off soak between cycles, and adjust dynamometer controls to meet statistical requirements for transient cycle operation.
7	Soak engine overnight. Run a cold-start transient cycle. Soak engine for 20 minutes. Run a hot-start transient cycle. Collect samples for NMHC, CO, NO_x, total particulate, speciation of volatile hydrocarbon compounds, aldehydes, ketones, PAH, and NPAH during each cycle.
8	Repeat Step 7 two additional times on different days.
9	Repeat steps 4 through 8 with the aftertreatment device removed and a blank spool piece in place of the aftertreatment device.
10	Perform fuel change procedure to Fuel RDB5. Change oil, oil filter, fuel filters, purge fuel supply, etc. (**Note:** No other fuel should be used until testing with this fuel has been completed.) Perform engine operation for 125 hours. If unscheduled maintenance is necessary, the repairs will be made to Original Equipment Manufacturer (OEM) specifications using OEM or OEM approved parts. In addition, emissions should be measured after any unscheduled maintenance before resuming durability, to ensure that post-maintenance emission levels are within ±20 percent of the pre-maintenance emission levels
11	Repeat Steps 4 through 9.

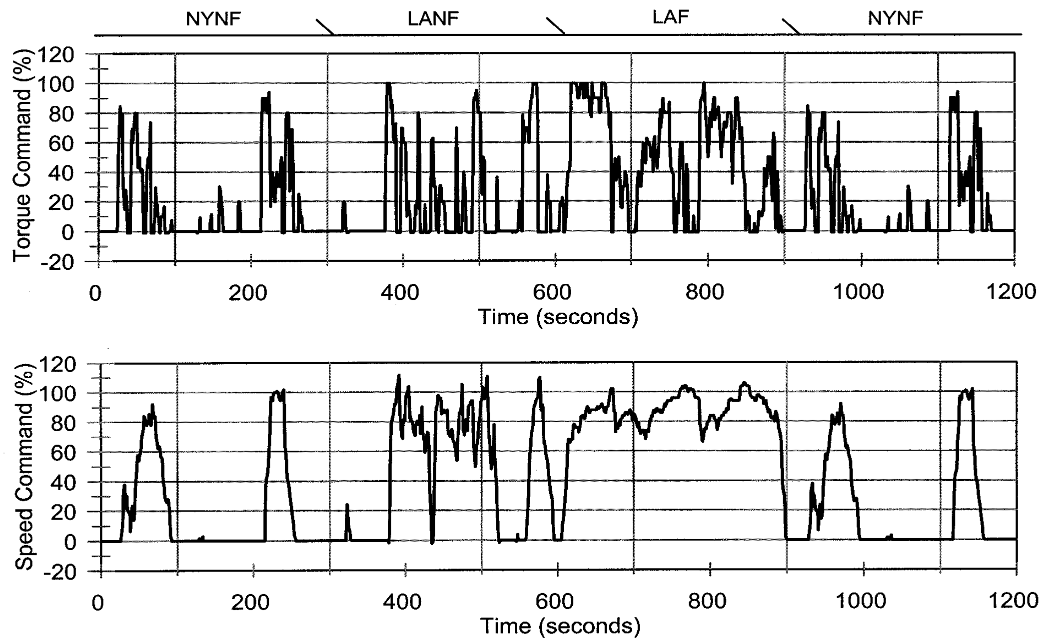


FIGURE 1. GRAPHIC REPRESENTATION OF TORQUE AND SPEED COMMANDS FOR THE EPA TRANSIENT CYCLE FOR HEAVY-DUTY ENGINES

In general, a transient test consists of both cold- and hot-start EPA transient cycle operation. The same engine command cycle is used in both cases. For the cold-start, the diesel engine is operated over a "prep" cycle and then allowed to stand overnight in an ambient soak at a temperature between 68° and 86°F. The cold-start transient cycle begins when the engine is cranked for cold start-up. Upon completion of the cold-start transient cycle, the engine is stopped and allowed to stand for 20 minutes. After this hot-soak period, a hot-start EPA transient cycle begins with engine cranking. In order to determine how well the engine followed the transient command cycle, engine performance is compared to engine command, and several statistics are computed. These computed statistics must be within tolerances specified in the Title 40 CFR Part 86, Subpart N, Section 86.1341-90. In addition to statistical parameters, the cycle work actually produced should be between 5 percent above and 15 percent below the work requested by the command cycle.

2.2.2 Heavy-Duty Engine Selection and Description

For the purpose of testing, a 2011 6.7L Ford Diesel engine (Serial No. E1116 1904110157172) was selected and purchased for KiOR, Inc. The engine was selected to meet the following criteria:

- Less than 12 hours of previous engine operation
- Same type, class, and subclass which consumed the most gallons of fuel in the fuel family over the past three years

- Represent the most common fuel metering system and the most common of the most important emission control system devices or characteristics with respect to the emission reduction performance for the model year in which testing began
- One of the five highest selling models from the current model year
- Unaltered from the specification of the original equipment manufacturer and to remain under the control of SwRI throughout the testing.

Table 2 lists the engine specifications and features.

TABLE 2. ENGINE SPECIFICATIONS AND FEATURES

ENGINE PARAMETER	COMMENT
Engine Type	Diesel, 4-Cycle
Model	2011 Ford 6.7L
Serial No.	E1116 1904110157172
Configuration	4 OHV/1 Cam-in-Crankcase V-8
Displacement	6.7L (409 cu. in.)
Bore and Stroke	99 x 108 mm (3.90 x 4.25 in)
Compression Ratio	16.1:1
Induction	DualBoost Variable Geometry Turbocharger
Rated Power at rpm	300 hp at 2800 rpm
Peak Torque at rpm	660 lb-ft at 1600 rpm
Idle Speed	600 rpm
Combustion System	High Pressure Common Rail Direct Injection, Turbocharged, Electronic Control Module, Charge Air Cooling, Exhaust Gas Recirculation
Engine Family	BFMXH06.7A24
Aftertreatment	Diesel Oxidation Catalyst/Diesel Particulate Filter/Selective Catalytic Reduction Catalyst

2.2.3 Durability Cycle and Engine Mapping

After the engine was received, it was operated for 125 hours with the base diesel fuel using a durability cycle derived from a proprietary cycle obtained from Ford Motor Company. This durability cycle was performed to obtain the designated hours of engine operation prior to conducting the baseline emission tests. Engine durability was performed with full aftertreatment and SCR enabled. At the completion of the baseline tests, the same durability cycle was used with Fuel RDB5, and emission testing was performed after 125-hour of engine operation. Figure 2 and Figure 3 illustrate the engine map used for the base fuel and for Fuel RDB5.

2.2.4 Fuel Blending and Analyses

The baseline diesel durability fuel was coded EM-7007-F. This fuel was approved for use as the durability fuel in this program based on a waiver obtained from Mr. Jim Caldwell on May 2, 2007 which allowed the use an ultra-low sulfur fuel in place of the previously required

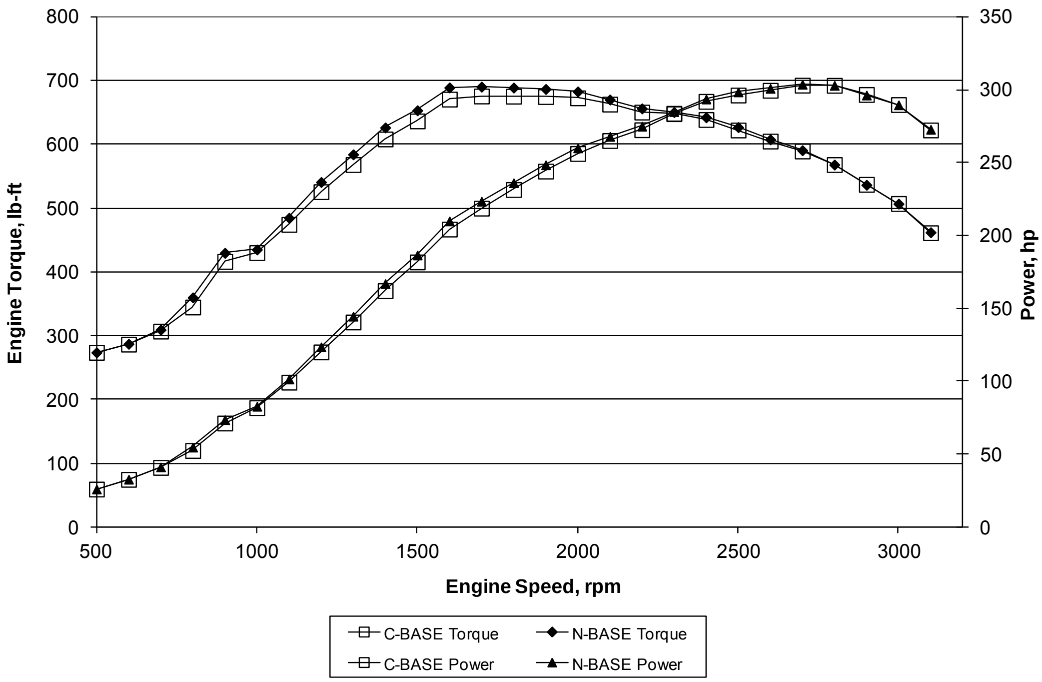


FIGURE 2. SPEED AND TORQUE MAP FOR BASE FUEL AFTER 125 HOURS OF DURABILITY

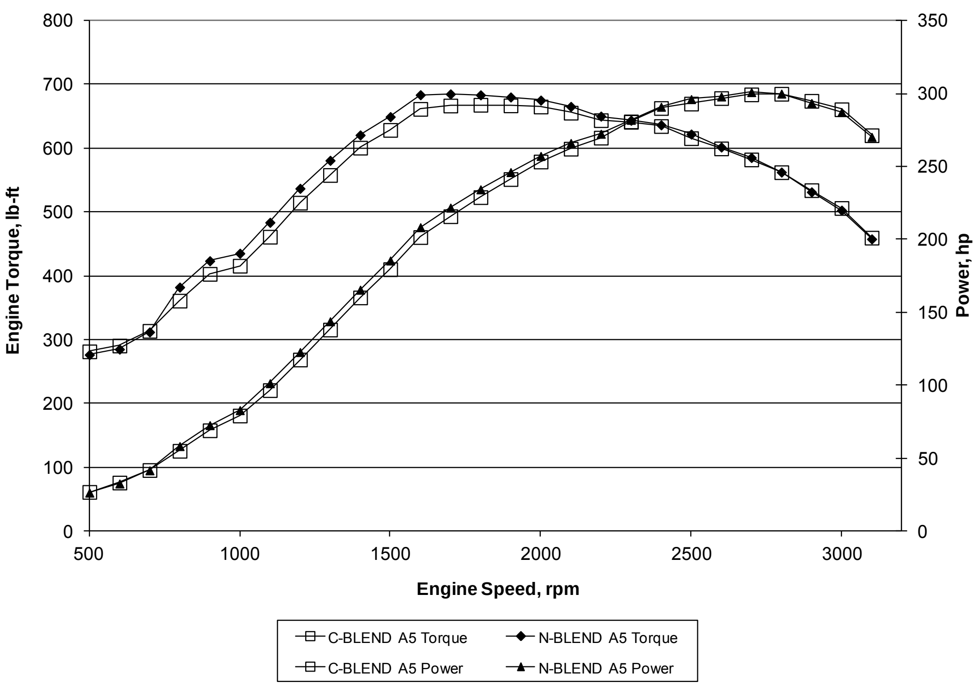


FIGURE 3. SPEED AND TORQUE MAP FOR FUEL RDB5 AFTER 125 HOURS OF DURABILITY

TABLE 3. FUEL ANALYSES AND SPECIFICATIONS

FUEL CODE	TEST METHOD	211(b)[a]	ASTM D975	EM-7007-F DURABILITY BASE FUEL[a]	EM-8034-F EMISSIONS BASE FUEL[a]	EM-8040-F EMISSIONS FUEL - RDB5[a]
Sulfur, ppm	D5453	<15[b]	<15	7.8	12.3	12.0
Aromatics, vol %	D1319	38.4 ± 2.7	35 max.	40.9	27.9	30.7
Olefins,vol %	D1319	1.5 ± 0.4	NA[c]	5.6	3.3	4.0
Saturates, vol %	D1319	60.1 ± 2.0	NA	53.5	68.8	65.3
Cetane Number	D613	45.2 ± 2	40 min.	41.5	44	41.1
Cetane Index	D976	45.7 ± 2	40 min.	41.5	45	44.3
API Gravity	D287	33±1	NA	31.3	35	34.2
IBP, °F	D86	NA	NA	374.2	NA	366.0
10%, °F		433 ± 5	NA	423.6	418	414.0
50%, °F		516 ± 5	NA	510.2	497	496.9
90%, °F		606 ± 5	540 - 640	598.3	577	578.1
EP, °F		NA	NA	642.2	NA	625.2

[a]Includes 4.5 pounds per thousand barrels (ptb) corrosion inhibitor, 2 ptb demulsifier, 2 ptb anti-oxidant, and 2 ptb metal deactivator
[b]40 CFR Part 79 Subpart F 79.55 specifies 500 ± 25 ppm sulfur, but current fuel specifications require <15 ppm
[c]NA-Not applicable

low sulfur fuel. This change was made because modern engines cannot tolerate higher sulfur concentrations due to the use of aftertreatment systems for emissions reduction. Prior to performing the emissions testing, the fuel was changed to the baseline emissions fuel which was coded EM-8034-F, and this fuel met the requirements of Title 40 CFR Part 86, Subpart N, 86.1313-2007 except it contained the required 40 CFR Part 79 Subpart F additives for corrosion inhibitor, demulsifier, anti-oxidant, and metal deactivator. This fuel also had less than 15 ppm sulfur as opposed to the 500 ± 25 ppm sulfur stated in 40 CFR Part 79 Subpart F. A second waiver was obtained from Mr. Jim Caldwell for the use of this 40 CRF Part 86 certification fuel as the emissions fuel in a letter dated August 31, 2011. This second waiver allowed the use of ultra-low sulfur fuel with an aromatic content more in line with current fuels used for emissions testing.

The KiOR Distillate was designated as EM-8030-F. This KiOR Distillate blendstock was used to create a 5 volume percent blend with base diesel fuel (EM-8034-F) for emissions testing. This fuel was called KiOR Renewable Diesel Blendstock 5 and was identified as EM-8040-F. Table 3 presents the test fuel properties and the fuel specifications for comparison.

3.0 DESCRIPTION OF ANALYTICAL METHODS

Regulated and unregulated emission measurements conducted for this program, as required by the EPA, included the following:

- Measurement of regulated emissions including NMHC, CO, NO_x, and total particulate,
- Speciation of volatile-phase hydrocarbon compounds, aldehydes, and ketones,
- Semi-volatile emissions for both volatile- and particulate-phase PAH and NPAH including: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-c,d]pyrene, 7-nitrobenzo[a]anthracene, 6-nitrobenzo[a]pyrene, 6-nitrochrysene, 2-nitrofluorene, and 1- nitropyrene.

Regulated emissions (NMHC, CO, NO_x, and particulate) and CO_2 were analyzed according to Title 40 CFR, Subpart N specifications, and all applicable accuracy and calibration requirements were met. All filters were conditioned and weighed in accordance with the appropriate sections of the CFR for heavy-duty engines. Two sizes of filters were used to collect particulate samples. These filters included the following for each test:

- One set of 90-mm Pallflex (fluorocarbon-coated glass fiber) filters for determination of the regulated total particulate mass rate,
- One 20×20-inch Pallflex filter for dilute exhaust filtration of particulate and subsequent extraction for PAH and NPAH.

Analyses of unregulated emissions were conducted according to Coordinating Research Council (CRC), EPA, and SwRI analytical procedures. Applicable SwRI TIPs are listed in References 1 through 17. Table 4 presents the sampling requirements for each of the measured emissions, and Figure 4 shows a drawing of the engine, dilution tunnel, and sampling locations. Impingers with dinitrophenylhydrozene (DNPH)/acetonitrile solutions were employed to collect aldehydes and ketones, and Tedlar® bags were used for collection gaseous emissions. These sampling techniques are discussed in more detail below.

2.3 Regulated Emissions

Regulated emissions were quantified in a manner consistent with EPA protocols for heavy-duty emissions testing as given in Title 40 CFR Part 86, Subpart N. Analysis of the regulated emissions was performed continuously throughout the entire test. The exhaust gas samples for CO and CO_2 were analyzed using non-dispersive infrared (NDIR) instruments, and the NMHC and NO_x were monitored using a flame ionization detector and a chemiluminescent instrument, respectively. Methane emissions were measured by method described in Section 2.4.1. The results of the methane emission measurements were used to calculate the regulated NMHC emissions.

TABLE 4. SAMPLE COLLECTION METHODS

TEST NUMBER	REGULATED NMHC, CO, NO_X, and PARTICULATE	SPECIATION $C_1 - C_{12}$	PAH/NPAH		ALDEHYDES and KETONES
			Particulate	Volatile	
Base Fuel with Aftertreatment[a,b]					
C-BA-C1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-BA-H1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-BA-C2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-BA-H2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-BA-C3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-BA-H3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
Base Fuel without Aftertreatment[b,c]					
N-BA-C1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-BA-H1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-BA-C2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-BA-H2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-BA-C3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-BA-H3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
RDB5 with Aftertreatment[a,d]					
C-A5-C1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-A5-H1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-A5-C2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-A5-H2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-A5-C3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
C-A5-H3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
RDB5 without Aftertreatment[b,d]					
N-A5-C1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-A5-H1	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-A5-C2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-A5-H2	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-A5-C3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger
N-A5-H3	Cont., Bag, 90mm Filter	Bag	20X20 Filter	PUF	Impinger

[a] Tests "C-" conducted with the aftertreatment in place.
[b] Tests "BA" conducted with base fuel
[c] Tests "N-" conducted with the aftertreatment removed.
[d] Tests "A5" conducted with RDB5

2.4 Speciation of Volatile Hydrocarbon Compounds

Volatile hydrocarbon compounds were determined by hydrocarbon speciation. Analytical procedures for conducting the hydrocarbon speciation (C_1 to C_{12} hydrocarbons, aldehydes, and ketones) were similar to the CRC Auto/Oil Phase II methods. The SwRI TIPs for this determination are listed in the Reference Section. With these methods, exhaust emission samples were analyzed for the presence of more than 200 different hydrocarbon exhaust species. Four gas chromatography (GC) procedures and one High Performance Liquid Chromatography (HPLC) procedure were used to identify and quantify specific compounds. One GC was employed for the measurement of methane, a second for C_2-C_4 species, and a third for C_5-C_{12} species including some of the higher molecular weight alcohols and ethers. A fourth GC was used to measure 1-methylcyclopentene, benzene, toluene, 2,3-dimethylhexane, cyclohexane, and 2,3,3-trimethylpentane, which co-elute and cannot be accurately quantified by other methods. Analysis of all emission "sample" bags were begun within 30 minutes of sampling and before the "background" bags, so that reactive exhaust compounds could be analyzed as quickly as possible. Data were reported as background corrected. A brief description of these procedures is given in the following sections.

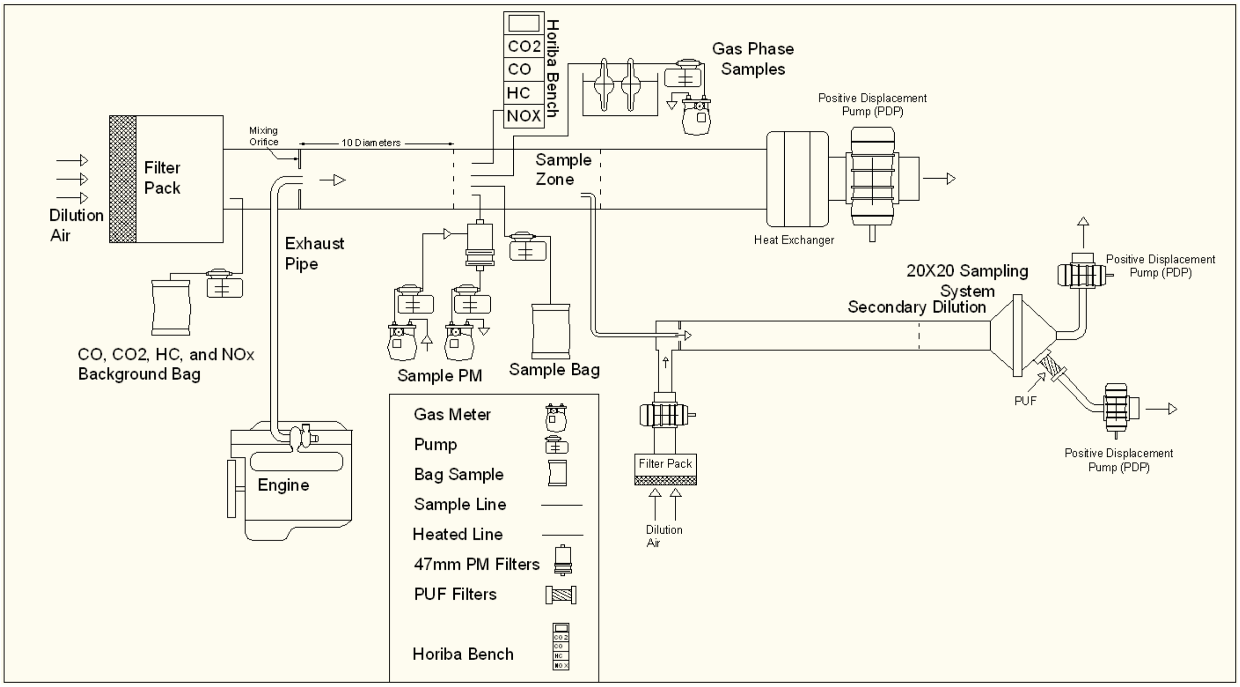


FIGURE 4. SAMPLE SYSTEM SCHEMATIC FOR EXHAUST EMISSION MEASUREMENTS

2.4.1 Methane Speciation

Methane levels were determined for proportional exhaust gas samples collected in Tedlar® bags and as described in SwRI TIP 07C-002. A GC equipped with a flame ionization detector (FID) was utilized for the analyses, and was used in accordance with SAE J1151 procedures. The GC system was equipped with a packed column to resolve methane from other hydrocarbons in the sample. Samples were introduced into a 5-mL sample loop via a diaphragm pump. For analysis, the valve was switched to the inject position, and the helium carrier gas swept the sample from the loop toward the detector through a 61 cm × 0.3 cm Porapak N column in series with a 122 cm × 0.3 cm molecular sieve 13X column. As soon as the methane peak passed into the molecular sieve column, the helium flow was reversed through the Porapak N column to vent. For quantification, sample peak areas were compared to those of external calibration standards. Detection limits for the procedure were on the order of 0.05 mg/bhp-hr in dilute exhaust.

2.4.2 C_2-C_4 Species

SwRI TIP 07C-013 describes the analytical procedure for determining the C_2-C_4 hydrocarbons. With the aid of a DB-WAX pre-column and a 10-port switching valve, this procedure allowed the separation and determination of exhaust concentrations of C_2-C_4 individual hydrocarbon species, including: ethane; ethylene; acetylene; propane; propylene; trans-2-butene; butane; 1-butene; 2-methylpropene (isobutylene); 2,2-dimethypropane (neopentane); propyne; 1,3-butadiene; 2-methylpropane; 1-butyne; and cis-2-butene. Bag samples were analyzed with a GC system which utilized an Agilent Model 7890 Series A GC with an FID, two pneumatically operated and electrically controlled valves, and two analytical columns. The first column separated the C_2-C_4 hydrocarbons from the higher molecular weight hydrocarbons and the polar compounds. These higher molecular weight hydrocarbons (and water and alcohols) were retained on the pre-column while the C_2-C_4 hydrocarbons were passed through to the analytical column (50 m Alumina PLOT/KCl with 10 μm film thickness and 0.53 mm i.d.). At the same time, the C_2-C_4 hydrocarbons were separated on the analytical column, the pre-column was back-flushed with helium to prepare for the next analysis. The carrier gas for this analysis was helium. The GC was calibrated daily using a CRC Auto/Oil 23-component calibration mixture. Analysis for the C_2-C_4 hydrocarbons was typically begun within 30 minutes after sample collection was completed. Detection limits for the procedure were on the order of 0.05 mg/bhp-hr in dilute exhaust for all compounds.

2.4.3 C_5-C_{12} Species

SwRI TIP 07C-013 describes the analytical procedures for the C_5-C_{12} hydrocarbons. This procedure provides separation and exhaust concentrations for more than 200 C_5-C_{12} individual hydrocarbon compounds. Bag samples were analyzed using a gas chromatograph equipped with an FID. The GC system utilized an Agilent Model 7890 Series A GC with an FID, a pneumatically operated and electrically controlled valve, and a 60 m DB-1 fused silica open tubular (FSOT) column with a 1.0 μm film thickness and a 0.32 mm i.d. The carrier gas was helium. Gaseous samples were pumped from the bag through a sample loop and then introduced into a liquid nitrogen cooled column. The column oven was then programmed to a maximum temperature of 200°C. The analog signal from the FID was sent to a networked computer system via a buffered analog to digital converter. The GC was calibrated daily using a CRC Auto/Oil 23-component calibration mixture. Detection limits for the procedure were on the order of 0.05 mg/bhp-hr in dilute exhaust for all compounds.

2.4.4 Benzene and Toluene

The analytical procedure for benzene and toluene is also described in SwRI TIP 07C-013. This procedure used a separate system configured similarly to the C_5-C_{12} GC method (with a 30 m DB-5 analytical column in place of the DB-1 FSOT column) to resolve individual concentrations of benzene and toluene according to the CRC Auto/Oil Phase II Protocols. Separation of benzene and toluene from co-eluting peaks was carried out by fine-tuning the column head pressure to give benzene a retention time of 22 to 23 minutes. The GC was calibrated daily using a CRC 7-component calibration mixture. Detection limits for the procedure were 0.05 mg/bhp-hr in dilute exhaust for all compounds.

2.4.5 Aldehydes and Ketones

An HPLC procedure was used for the analysis of aldehydes and ketones. SwRI TIP 07C-006 describes the analytical procedure. Samples were collected in impingers filled with DNPH/Acetonitrile solution at a nominal flow rate of 2 L/min. SwRI TIP 07C-010 covers the sampling of aldehydes and ketones with DNPH cartridges. Samples were analyzed immediately or stored in ground glass stopped vials at 0°C for no more than one week prior to analysis. For analysis, a portion of the acetonitrile solution was injected into a liquid chromatograph equipped with an ultra-violet (UV) detector. External standards of the aldehyde and ketone DNPH derivatives were used to quantify the results. The aldehydes and ketones include: formaldehyde, acetaldehyde, acrolein, acetone, propionaldehyde, crotonaldehyde, n-butyraldehyde, methylethylketone, benzaldehyde, isovaleraldehyde, valeraldehyde, o-tolualdehyde, m-tolualdehyde/p-tolualdehyde (not resolved from each other during normal operating conditions, and so reported together), hexanaldehyde, and 2,5-dimethylbenzaldehyde. Detection limits for this procedure were on the order of 0.05 mg/bhp-hr aldehyde or ketone in dilute exhaust, and the limit of quantification was 0.1 mg/bhp-hr.

2.5 PAH and NPAH

In addition to the regulated and C_1 to C_{12} hydrocarbon exhaust emissions, semi-volatile (volatile- and particulate-phase) PAH and NPAH compounds were also determined for each fuel. Seven PAH compounds were quantified: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene; and five NPAH compounds: 7-nitrobenzo[a]anthracene, 6-nitrobenzo[a]pyrene, 6-nitrochrysene, 2-nitrofluorene, and 1-nitropyrene. A 400 in^2 fluorocarbon-coated glass fiber filter (20×20-inch Pallflex filter) was used to collect the particulate-phase PAH and NPAH, and a PUF/XAD/PUF sandwich adsorbent trap was used to collect the volatile-phase PAH and NPAH. The PUF/XAD/PUF traps contained a layered sampling media consisting of a 1.25 inch deep layer of polyurethane foam (PUF), a 0.5 inch deep layer of XAD-2 resin, and a second 1.25 inch deep layer of PUF. The XAD-2 resin was incorporated to improve the trapping efficiency for the lighter PAH and NPAH compounds.

Volatile-phase PAH and NPAH samples presented a particular problem for heavy-duty sampling because conventional sampling techniques would not allow for sufficient sample to be gathered to meet EPA detection requirements. Commercially available sampling media and hardware were of insufficient size to allow for the collection of sample volumes needed to meet these detection limits. Sampling media size was also limited by the ability to extract and concentrate samples obtained. Therefore, an approach was devised involving both custom built sampling hardware and a modified sampling plan. The PUF/XAD/PUF traps were sized to allow a media diameter of 4 inches, rather than the conventional 2.5 inches. This larger diameter allowed a much higher flowrate to be used, while maintaining the face velocity within recommended levels for the smaller, conventional sampling media. This volume of dilute exhaust sample was sufficient for the analysis to meet a detection threshold of 0.5 ng/hp-hr.

Prior to sampling, both XAD-2 and PUF sample media were cleaned. For cleaning the XAD-2, the material was cleaned by siphoning four times with water using a Soxhlet. The residual water was then removed under vacuum. The XAD-2 was then Soxhlet extracted three times: once with methanol for 24 hours, once with acetone for 48 hours, and finally with methylene chloride again for 48 hours. The residual methylene chloride was removed by purging with heated nitrogen. For cleaning the PUF material, each foam disk was washed with soapy water, rinsed with deionized water, air dried, Soxhlet extracted with acetone for 48 hours, and Soxhlet extracted with methylene chloride for 48 hours. The cleaned PUF was then air dried for 12 hours.

Volatile- and particulate-phase PAH and NPAH samples were obtained using a separate secondary dilution tunnel, which was operated in parallel with the smaller secondary dilution tunnel used to obtain the 90-mm filter samples for particulate mass determinations. The PAH and NPAH tunnel was considerably larger than the 90-mm system in order to allow for the use of 20×20-inch Pallflex sampling media to collect particulate-phase PAH and NPAH compounds and to allow the use of a specially designed PUF/XAD/PUF trap to collect the volatile-phase PAH and NPAH compounds. Filter and PUF/XAD/PUF trap samples were generated during each cold-start and a hot-start test. Background PAH and NPAH sample sets were obtained by operating the sampling systems for about two hours with sampling media loaded, but without the engine operating.

Following testing, sample sets were delivered to the analytical laboratory for extraction and analysis. In cases where immediate extraction was not possible, samples were stored at 4°C. One half of each filter and the entire PUF/XAD/PUF sample material were extracted separately. Prior to extraction of the filters, each filter was spiked with an internal standard solution containing 100 ng each of seven deuterated PAH:

- Benzo[a]anthracene-d12
- Chrysene-d12
- Benzo[b]fluoranthene-d12
- Benzo[k]fluoranthene-d12
- Benzo[a]pyrene-d12
- Indeno[1,2,3-cd]pyrene-d12
- Dibenzo[a,h]anthracene-d14

and four deuterated NPAH:

- 2-nitrofluorene-d9
- 1-nitropyrene-d9
- 6-nitrochrysene-d11
- 6-nitrobenzo[a]pyrene-d11.

This spiked internal standard was used to quantify the target PAH and NPAH in the sample. The filters were then Soxhlet extracted with methylene chloride for 10 hours and again with toluene for another 10 hours. For the PUF/XAD/PUF traps, each was spiked with the same amount of deuterated PAH and NPAH as used for the filters. The trap samples were then Soxhlet extracted for at 16 hours with methylene chloride. After extraction, the methylene chloride extract was reduced to 20 mL with a rotary evaporator with a water bath held at 35^{o}C. The concentrated extract was then split into two portions: 16 ml (80 percent) and 4 ml (20 percent). The 80 percent portion was blown down to about 0.5 ml, diluted to 6.0 ml with hexane, acid- and base-washed, and then column fractionated with a one inch silica gel column. The final sample extract was blown down to 100 µL, and this concentrated samples was analyzed for both PAH and NPAH. The 4 mL extract was saved as a reserve. The filter extract was treated similarly, and the unextracted filter half was saved as a reserve.

Samples for both the volatile- and the particulate-phase PAH and NPAH were analyzed by GC/MS (gas chromatograph/mass spectroscopy) using an Agilent 5973N MSD with a 30 m by 0.25 mm i.d. DB-5 column and a 0.25 µm film thickness. For each analysis, a 2 µL aliquot of the sample extract was injected into the instrument. A calibration curve consisting of at least five points was obtained prior to sample analysis to ensure linearity, and a mid-point continuing calibration was performed each day after the initial five point calibration. Analysis of NPAH compounds was performed using the negative ion/chemical ionization (NI/CI) mode and analysis for PAH compounds was performed using the positive ion/electron ionization (PI/EI) mode.

Two or three characteristic ions for each PAH and NPAH were monitored. Separate GC/MS analyses were necessary to acquire both the PAH and NPAH data. Each target compound met the criterion of a 30 percent relative response factor (RRF) and 30 percent deviation in relation to the mean RRF obtained in the initial and continuing calibration.

3.0 QUALITY CONTROL AND QUALITY ASSURANCE

In order to demonstrate SwRI's constant goal to provide quality emissions data in our project efforts, the Engine, Emissions, and Vehicle Research Division (EEVRD) maintains certification to ISO 9001:2000 and accreditation to ISO/IEC 17025:2005 standards. Standard operating procedures and routine instrument calibration and calibration records are included in these standards. Based on the successful completion of third party audits, the EEVRD is able to maintain registration under ISO 9001:2000, "Quality Management System," and accreditation by ISO/IEC 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories." The SwRI Office of Automotive Engineering (OAE) Quality Policy Statement:

SwRI OAE Quality Policy Statement

"The Office of Automotive Engineering provides unequaled capabilities for the research, development, evaluation, and qualification of transportation systems, vehicles, engines, fuels, lubricants, and emissions-related products. Quality excellence is the foundation for the management of our business and the keystone to customer satisfaction. It is our objective to ensure that our final products are internationally recognized with unquestioned quality and are delivered to our clients in a professional, cost effective, and timely manner.

We are committed to comply with ISO 17025, ISO 9001:2000, and all customer-required standards of excellence. Continual improvement of this policy occurs through regular review of the quality system's suitability to meet customer, employee, and supplier needs."

Throughout this project, SwRI implemented our QA/QC plan in a manner consistent with the program objectives, including spot-checking of records, accuracy/precision charts, notebooks, calibration tags, and other quality control elements including chain of custody of samples. Listed below are a few of the key process that ensure the quality standards are implemented.

Senior Scientist/Technician Review - A system for formal data review is in place in the SwRI Department of Emissions Research and Development (DER&D). All technicians review their work prior to submitting it to the data computations laboratory for calculation of final concentrations. The Project Leader performs the final review before test results are accepted.

Interlaboratory Comparisons/Round Robins - SwRI has participated in numerous Round Robin exercises to correlate the results of our laboratory with other accepted facilities. Those Round Robin studies which are directly related to this project include: CRC Round Robin Analysis of Alcohol and Carbonyl Synthetic Exhaust Samples (results published in SAE Paper No. 941944); and CRC Round Robin Hydrocarbon Speciation Analysis of Synthetic Exhaust Gas (results not published).

Project Records - Documents directly associated with a technical project, such as: correspondence, proposals, contracts, work orders, interim and final reports, and follow-up contacts are maintained. These records are handled in accordance with Standard Operating Procedure (SOP), document SOP-4.16 "Quality Records" (Reference 17).

Calibration Records - Data sheets, chart recordings, computer printouts, logbooks, calibration and maintenance logs, and spreadsheets associated with the calibration of measurement equipment are maintained. Calibration results from external suppliers are also included.

Engine and Vehicle Testing Records - Data sheets, chart recordings, logbooks, start/stop logs, and computer printouts associated with evaluation and testing of engines and vehicles are retained.

Chemistry Calibration and Analysis Records - Data sheets, logbooks, and spreadsheets associated with calibration and analyses performed in the chemistry areas are retained.

Data Reduction and Test Result Records - Computed results, tables, and spreadsheets generated using information obtained from emissions testing and chemical analyses are maintained. Records developed in the areas specified in SOP 4.16 are retained for a period of ten years.

Training and Competency Evaluation: Personnel are trained to applicable SOP, TIP, and Design and Analysis Procedures and Safety Requirements. Staff members that perform an individual test are certified before performing these tests without supervision. Management encourages personnel to avail themselves to attend appropriate seminars, conferences, and continuing/higher education opportunities to continually enhance their skill set.

4.0 TEST RESULTS

Emissions testing was performed using a 2011 6.7L Ford Diesel engine. This engine was operated for 125 hours with the base diesel fuel. Three cold- and hot-start test sequences were conducted with the engine exhaust aftertreatment in place, and three cold- and hot-start test sequences were performed with the aftertreatment removed. The fuel was then changed to Fuel RDB5, and the test sequence was repeated. Results of these tests are presented below.

4.1 Regulated Emissions

The 2011 heavy-duty emission standards for NMHC, CO, NO_x, and particulate for Model 2007 and later engines are 0.14, 15.5, 0.20, and 0.01 g/bhp-hr, respectively. After 125 hours of engine operation with the base diesel fuel, the average composite emissions with aftertreatment were significantly lower than the corresponding 2011 emission standards. Without aftertreatment, the average composite emissions were able to meet the standards for the NMHC and CO; but the NO_x and particulate emissions were higher than the standard. In general, operating the engine without aftertreatment would not be expected to meet these standards since the engine was designed to employ aftertreatment. Table 5 summarizes the regulated emissions at each test condition. Appendix A contains the individual and composite emission test results.

After 125 hours of engine operation with RDB5, the NMHC were significantly lower than with the initial tests using the base fuel when the aftertreatment was present. The CO and particulates were at the same level as with the base fuel emissions. NO_x was slightly higher than the base fuel emission levels (0.06 g/bhp-hr versus 0.05 g/bhp-hr); however, both were sufficiently lower than the 2011 emission standards (0.20 g/bhp-hr). When the aftertreatment was removed, the average composite emissions were still able to meet the standards for the NMHC and CO; but the NO_x and particulate emissions were higher than the standard. An increase of 0.01 g/bhp-hr in NO_x with RDB5 was noted with both aftertreatment and without aftertreatment. No relative change was noted for the particulate and CO with aftertreatment when compared to the baseline fuel. NMHC emission reductions were observed for the emissions with RDB5 when compared to the baseline fuel for both types of the tests, with and without aftertreatment. Table 5 summarizes the regulated emissions at each test condition, and Appendix A contains the individual and composite emission test results. Figure 5 and Figure 6 illustrate combined results for base and candidate fuels emissions with and without aftertreatment.

4.2 Speciation of Volatile Hydrocarbon Compounds

Speciation results for volatile hydrocarbon compounds with carbon numbers from C_1 to C_{12} plus aldehydes and ketones are included in this section. Speciation was performed on samples collected during each cold- and hot-start test sequence both with and without aftertreatment. More than 200 compounds were checked for their presence in the dilute exhaust. Data for the individual compounds, corrected for background dilution air contributions, are included in Appendix B.

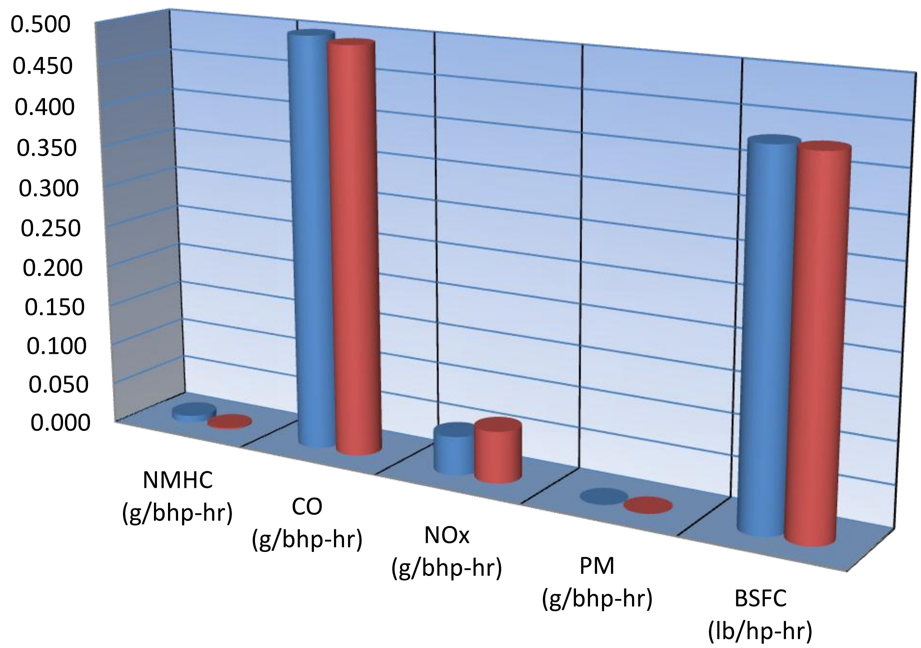
TABLE 5. SUMMARY OF REGULATED EMISSIONS

TEST	EMISSIONS RESULTS, g/bhp-hr			
	NMHC	**CO**	**NO_X**	**PARTICULATE**
Heavy-Duty Standards 2007 and Later Models	0.14	15.5	0.20	0.010
Baseline Fuel With Aftertreatment				
C-BA-C1	0.011	0.9	0.21	0.003
C-BA-H1	0.017	0.5	0.03	0.000
Composite C1-H1	***0.016***	***0.5***	***0.06***	***0.001***
C-BA-C2	0.012	0.8	0.18	0.000
C-BA-H2	0.008	0.5	0.02	0.000
Composite C2-H2	***0.009***	***0.5***	***0.05***	***0.000***
C-BA-C3	0.000	0.9	0.16	0.000
C-BA-H3	0.000	0.4	0.02	0.000
Composite C3-H3	***0.000***	***0.5***	***0.04***	***0.000***
Average of Composites	**0.008**	**0.5**	**0.05**	**0.000**
Baseline Fuel Without Aftertreatment				
N-BA-C1	0.216	3.7	0.72	0.298
N-BA-H1	0.132	3.6	0.71	0.304
Composite C1-H1	***0.144***	***3.6***	***0.71***	***0.303***
N-BA-C2	0.207	3.7	0.75	0.338
N-BA-H2	0.126	3.6	0.71	0.327
Composite C2-H2	***0.137***	***3.6***	***0.72***	***0.329***
N-BA-C3	0.208	3.7	0.75	0.306
N-BA-H3	0.121	3.6	0.71	0.304
Composite C3-H3	***0.134***	***3.6***	***0.71***	***0.304***
Average of Composites	**0.138**	**3.6**	**0.71**	**0.312**

TABLE 5 (CONT'D). SUMMARY OF REGULATED EMISSIONS

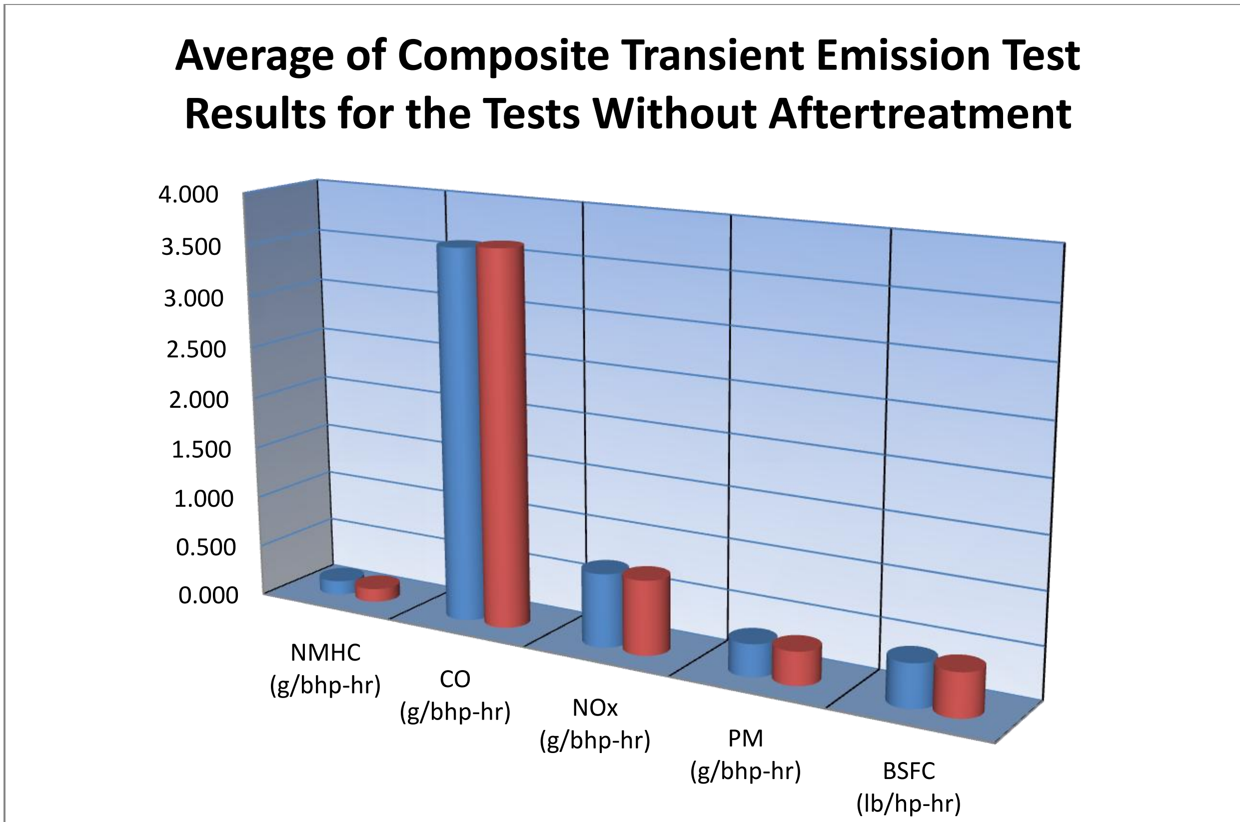
TEST	EMISSIONS RESULTS, g/bhp-hr			
	NMHC	**CO**	**NO_X**	**PARTICULATE**
RDB5 With Aftertreatment				
C-A5-C1	0.013	0.9	0.23	0.001
C-A5-H1	0.000	0.5	0.04	0.000
Composite C1-H1	***0.002***	***0.5***	***0.07***	***0.000***
C-A5-C2	0.022	0.9	0.24	0.000
C-A5-H2	0.000	0.4	0.01	0.000
Composite C2-H2	***0.003***	***0.5***	***0.05***	***0.000***
C-A5-C3	0.000	0.8	0.21	0.000
C-A5-H3	0.000	0.4	0.05	0.000
Composite C3-H3	***0.000***	***0.5***	***0.07***	***0.000***
Average of Composites	**0.002**	**0.5**	**0.06**	**0.000**
RDB5 Without Aftertreatment				
N-A5-C1	0.198	3.8	0.76	0.322
N-A5-H1	0.115	3.6	0.71	0.319
Composite C1-H1	***0.126***	***3.7***	***0.72***	***0.320***
N-A5-C2	0.199	3.8	0.75	0.315
N-A5-H2	0.116	3.6	0.72	0.324
Composite C2-H2	***0.128***	***3.7***	***0.73***	***0.323***
N-A5-C3	0.196	3.8	0.77	0.320
N-A5-H3	0.123	3.6	0.72	0.324
Composite C3-H3	***0.134***	***3.6***	***0.73***	***0.324***
Average of Composites	**0.129**	**3.6**	**0.72**	**0.322**

Average Of Composite Transient Emission Test Results for the Tests With Aftertreatment



	NMHC (g/bhp-hr)	CO (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	BSFC (lb/hp-hr)
Base Fuel	0.008	0.5	0.05	0.000	0.43
Renewable Fuel Blend	0.002	0.5	0.06	0.000	0.43

FIGURE 5. AVERAGE OF COMPOSITE EMISSIONS WITH AFTERTREATMENT



	NMHC (g/bhp-hr)	CO (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	BSFC (lb/hp-hr)
Base Fuel	0.138	3.6	0.71	0.312	0.42
Renewable Diesel Blend	0.129	3.6	0.72	0.322	0.42

FIGURE 6. AVERAGE OF COMPOSITE EMISSIONS WITHOUT AFTERTREATMENT

Speciated emission profiles were substantially similar for both the base fuel and RDB5. Some compounds were found in either one or more of the cold- or one or more of the hot-start tests during the triplicate test sequence with each fuel. Values were reported when these compounds were detected at the limit of quantification which was more than two times the detection limit (0.05 mg/bhp-hr). In other cases, compounds were detected at less than two times the limit of quantification and above the detection limit. In these cases, the compounds were labeled as “TRACE” in the appendix tables. Where compounds were not detected (i.e. below the detection limit), ND was used to indicate that no quantitative value could be assigned to the compound for that test. Average values were also reported for the composite results with each fuel. For these averages, values reported as ND and TRACE were set to zero for calculation purposes.

With aftertreatment, all compounds present in the exhaust with RDB5 were present in similar amounts to the exhaust with the base fuel. Six compounds (methane, trans-2-nonene, decane, isobutylbenzene, formaldehyde, and acetaldehyde) were present at higher level with base fuel than with RDB5. Only one hydrocarbon, 1,2,4-trimethylbenzene, was present at the level higher with the candidate fuel than with the base fuel.

A number of compounds were detected with both fuels without aftertreatment that were not detected with aftertreatment. Thirteen (13) components were detected in the exhaust with base fuel that were not detected in the exhaust with candidate fuel. These compounds included:

- 3-methyl-1-pentene
- cyclopentene
- 4-methyl-cis-2-pentene
- cyclopentane
- 2-methyl-1-pentene
- 1,4-dimethyl-2-ethylbenzene
- 2,5-dimethylheptane
- 3,5-dimethylheptane
- 1,3,5-trimethylbenzene
- 1,2,3,5-tetramethylbenzene
- tert-1-butyl-4-ethylbenzene
- 1-trans-2-cis-4-trimethylcyclopentane
- 1-methyl-1-ethyl-cyclopentane

Only two compounds (2-methyl-2-pentene and 2,2,3-trimethylpentane) were detected in the exhaust with RDB5 without aftertreatment that were not detected in the exhaust with the base fuel.

Without aftertreatment, some components were at levels higher with the base fuel than with RDB5. These compounds included:

- methane
- trans-2-pentene
- styrene

Without aftertreatment, two of the components were at slightly higher levels with RDB5 than with the base fuel. These components include hexane and 2-methyloctane.

In general, all of the compounds detected with aftertreatment were lower than without aftertreatment, and the concentrations were similar for both fuels. With aftertreatment, no additional compounds were detected with RDB5 which were not detected with the base fuel. Without aftertreatment, more components were detected in the exhaust with base fuel than in exhaust with candidate fuel. Speciated profiles for both tests, with and without aftertreatment, looked similar for the base and RDB5.

4.3 PAH and NPAH

Volatile- and particulate-phase PAH and NPAH compounds were determined for each test condition. Individual compounds included: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, 7-nitrobenzo[a]anthracene, 6-nitrobenzo[a]pyrene, 6-nitrochrysene, 2-nitrofluorene, and 1-nitropyrene. The analytical procedure was able to detect less than 1 ppm (equivalent to 0.001 µg of compound per mg of organic extract) in the extractable organic material. The concentration of each individual PAH or NPAH has been reported in units of ng/bhp-hr. Each compound, which was present at 0.5 ng/bhp-hr or greater, was identified, measured, and reported in terms of ng/bhp-hr. Table 6 and Figure 7 present the individual volatile-phase results, and Table 7 and Figure 8 and 9 present the individual particulate-phase results. (NOTE: The volatile NPAHs were not presented in graph form because all average values were TRACE or ND) Table 8 and Figure 10 and 11 summarize the combined volatile- and particulate-phase results.

In general, the concentrations of PAH and NPAH were lower with aftertreatment than without it. In addition, the individual concentrations of PAH and NPAH in the volatile-phase were generally lower than the individual concentrations of the PAH and NPAH in the particulate-phase. With and without aftertreatment, 1-nitropyrene was detected at the highest concentration for all of the NPAHs in the particulate-phase. With aftertreatment, it was at sufficiently lower level for the tests with RDB5. Without aftertreatment, 1-nitropyrene level was lower for the tests with base fuel.

The individual PAHs were generally higher in concentration than the NPAHs. With aftertreatment, the average composite PAHs in volatile phase were below the quantification limit with the exception of indeno[1,2,3-cd]pyrene, which was at a higher level in the exhaust with the base fuel. Without aftertreatment, most of PAH in volatile phase were at a higher level in the exhaust with the base fuel than in the exhaust with RDB5.

With aftertreatment, most of the PAHs in the particulate phase were at a higher level with the base fuel with one exception, indeno[1,2,3-cd]pyrene, which was at a slightly higher level with RDB5. Without aftertreatment, the PAHs in the particulate phase were at comparable levels in the exhaust with both the base fuel and RDB5.

Overall, total PAH with and without aftertreatment was either higher with the base fuel or at the comparable levels with RDB5. While the some of the PAH and NPAH were not detected, one cannot conclude that these compounds were present or not present; but if present, they were below the limits of detection.

TABLE 6. VOLATILE-PHASE PAH AND NPAH RESULTS

BASELINE FUEL WITH AFTERTREATMENT

COMPOUNDS[a]	C-BA-T1, ng/bhp-hr			C-BA-T2, ng/bhp-hr			C-BA-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	ND[b]	ND	ND	ND	1.2	1.1	6.6	ND	Trace[c]	Trace
1-Nitropyrene	ND	ND	ND	ND	Trace	Trace	ND	ND	ND	Trace
7-Nitrobenz(a)anthracene	Trace	Trace	Trace	ND	ND	ND	ND	ND	ND	Trace
6-Nitrochrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	2.3	1.9	ND	ND	ND	Trace
Benzo(b)fluoranthene	ND	ND	ND	ND	1.0	Trace	ND	ND	ND	Trace
Benzo(k)fluoranthene	ND	ND	ND	ND	1.4	1.2	ND	ND	ND	Trace
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	6.0	5.2	ND	ND	ND	1.7
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

BASELINE FUEL WITHOUT AFTERTREATMENT

COMPOUNDS[a]	N-BA-T1, ng/bhp-hr			N-BA-T2, ng/bhp-hr			N-BA-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	ND	Trace	Trace	3.9	ND	Trace	1.9	ND	Trace	Trace
1-Nitropyrene	Trace	Trace	Trace	Trace	ND	Trace	ND	Trace	Trace	Trace
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	32	12	14	75	5.6	16	18	17	17	16
Chrysene	71	30	35	100	22	33	21	32	30	33
Benzo(b)fluoranthene	100	46	54	146	44	59	22	25	25	46
Benzo(k)fluoranthene	33	13	16	49	13	18	9.4	8.0	8.2	14
Benzo(a)pyrene	69	23	30	85	20	29	28	23	23	27
Indeno[1,2,3-cd]pyrene	42	19	22	53	19	24	14	13	13	20
Dibenz(a,h)anthracene	20	9.3	11	25	8.3	11	5.0	2.9	3.2	8.2

[a]Detection limit in ng/bhp-hr calculated using the minimum value that could be quantified by the analytical procedure; if present, the PAH/NPAH was at a concentration less than 0.5 ng/bhp-hr.

[b]ND - None detected at the detection limit

[c]Trace - Value not quantifiable at detection limit; concentration less than twice the detection limit

TABLE 6 (CONT'D). VOLATILE-PHASE PAH AND NPAH RESULTS

RDB5 WITH AFTERTREATMENT										
COMPOUNDS[a]	C-A5-T1, ng/bhp-hr			C-A5-T2, ng/bhp-hr			C-A5-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	1.3	Trace[c]	Trace	Trace	ND[b]	Trace	1.1	Trace	Trace	Trace
1-Nitropyrene	Trace	Trace	Trace	Trace	Trace	Trace	Trace	ND	ND	Trace
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	1.3	ND	Trace	ND	ND	ND	Trace
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	6.8	ND	1.0	ND	ND	ND	Trace
Benzo(k)fluoranthene	ND	ND	ND	2.1	ND	Trace	ND	ND	ND	Trace
Benzo(a)pyrene	1.9	ND	Trace	6.9	ND	1.0	ND	ND	ND	Trace
Indeno[1,2,3-cd]pyrene	Trace	ND	ND	3.7	ND	Trace	ND	ND	ND	Trace
Dibenz(a,h)anthracene	ND	ND	ND	2.4	ND	Trace	ND	ND	ND	Trace

RDB5 WITHOUT AFTERTREATMENT										
COMPOUNDS[a]	N-A5-T1, ng/bhp-hr			N-A5-T2, ng/bhp-hr			N-A5-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	3.1	Trace	Trace	6.2	Trace	1.6	5.7	ND	Trace	1.1
1-Nitropyrene	Trace	ND	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene[a]	ND	ND	ND	ND	ND	ND	ND	Trace	Trace	Trace
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	31	27	24	6.1	8.7	ND	13	11	15
Chrysene	ND	34	29	29	11	13	Trace	25	22	22
Benzo(b)fluoranthene	ND	33	28	45	14	18	ND	28	24	24
Benzo(k)fluoranthene	31	29	29	17	5.2	6.9	ND	8.0	6.8	14
Benzo(a)pyrene	16	74	58	19	5.8	7.7	ND	7.8	6.7	24
Indeno[1,2,3-cd]pyrene	ND	18	16	21	6.3	8.4	Trace	15	13	13
Dibenz(a,h)anthracene	5.9	11	11	11	4.9	5.7	2.1	6.4	5.8	7.4

[a]Detection limit in ng/bhp-hr calculated using the minimum value that could be quantified by the analytical procedure; if present, the PAH/NPAH was at a concentration less than 0.5 ng/bhp-hr.

[b]ND - None detected at the detection limit

[c]Trace - Value not quantifiable at detection limit; concentration less than twice the detection limit

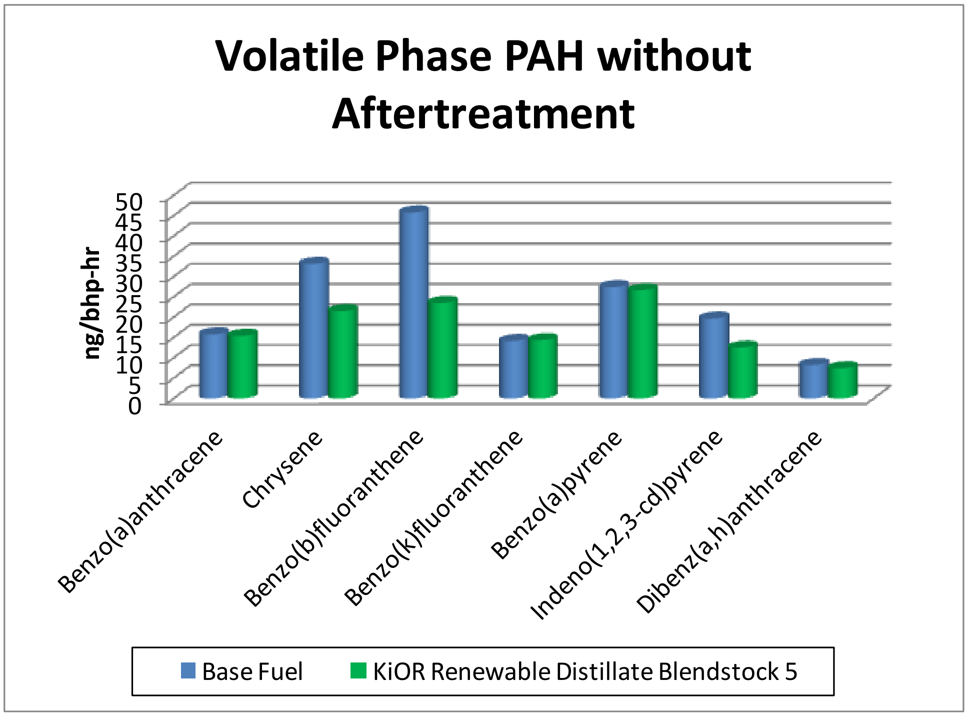


FIGURE 7. VOLATILE PHASE PAH WITHOUT AFTERTREATMENT

TABLE 7. PARTICULATE-PHASE PAH AND NPAH RESULTS

BASELINE FUEL WITH AFTERTREATMENT

COMPOUNDS[a]	C-BA-T1, ng/bhp-hr			C-BA-T2, ng/bhp-hr			C-BA-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	2.7	Trace[c]	Trace	2.0	Trace	Trace	Trace	ND[b]	Trace	Trace
1-Nitropyrene	89	8.0	20	14	1.4	3.2	15	3.3	5.1	9.2
7-Nitrobenz(a)anthracene	2.2	1.1	1.3	Trace	ND	Trace	Trace	ND	ND	Trace
6-Nitrochrysene	Trace	1.4	1.3	ND	ND	ND	ND	ND	ND	Trace
6-Nitrobenz(a)pyrene	4.0	1.7	2.0	2.0	ND	Trace	ND	ND	ND	Trace
Benzo(a)anthracene	27	24	25	12	5.1	6.1	5.1	3.0	3.3	11
Chrysene	66	34	38	19	6.5	8.3	12	2.7	4.0	17
Benzo(b)fluoranthene	73	47	51	24	9.6	12	14	5.1	6.4	23
Benzo(k)fluoranthene	11	14	14	5.6	2.9	3.3	1.8	1.2	1.3	6.1
Benzo(a)pyrene	2.6	19	17	5.0	Trace	1.3	ND	ND	ND	6.0
Indeno[1,2,3-cd]pyrene	1.4	15	13	4.9	1.9	2.3	ND	ND	ND	5.1
Dibenz(a,h)anthracene	1.9	5.0	4.5	3.1	1.7	1.9	Trace	Trace	Trace	2.3

BASELINE FUEL WITHOUT AFTERTREATMENT

COMPOUNDS[a]	N-BA-T1, ng/bhp-hr			N-BA-T2, ng/bhp-hr			N-BA-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	ND	ND	ND	ND	7.7	6.6	12	ND	1.7	2.8
1-Nitropyrene	433	331	345	367	175	203	274	210	219	256
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	2689	1552	1714	2847	1100	1350	2192	1366	1484	1516
Chrysene	2390	1235	1400	2299	942	1136	1863	1067	1180	1239
Benzo(b)fluoranthene	2856	1377	1588	2777	1053	1299	2220	1063	1228	1372
Benzo(k)fluoranthene	876	386	456	780	288	358	633	289	338	384
Benzo(a)pyrene	2788	1243	1463	2548	1112	1317	2210	988	1163	1314
Indeno[1,2,3-cd]pyrene	1120	453	549	790	368	429	837	362	430	469
Dibenz(a,h)anthracene	256	211	218	211	126	138	171	96	107	154

[a]Detection limit in ng/bhp-hr calculated using the minimum value that could be quantified by the analytical procedure; if present, the PAH/NPAH was at a concentration less than 0.5 ng/bhp-hr.

[b]ND - None detected at the detection limit

[c]Trace - Value not quantifiable at detection limit; concentration less than twice the detection limit

TABLE 7 (CONT'D). PARTICULATE-PHASE PAH AND NPAH RESULTS

RDB5 WITH AFTERTREATMENT										
COMPOUNDS[a]	C-A5-T1, ng/bhp-hr			C-A5-T2, ng/bhp-hr			C-A5-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	ND[b]	Trace[c]	Trace	3.6	Trace	Trace	3.4	Trace	Trace	Trace
1-Nitropyrene	7.2	3.4	3.9	12	3.0	4.3	9.9	1.2	2.4	3.6
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	8.9	7.5	7.7	6.9	6.2	6.3	4.6	6.0	5.8	6.6
Chrysene	14	15	15	10	5.6	6.3	8.2	6.0	6.3	9.2
Benzo(b)fluoranthene	14	18	18	11	8.7	9.0	8.4	13	13	13
Benzo(k)fluoranthene	3.8	5.0	4.8	4.4	3.8	3.8	2.2	5.1	4.7	4.5
Benzo(a)pyrene	3.9	3.5	3.6	4.0	2.6	2.8	ND	12	10	5.5
Indeno[1,2,3-cd]pyrene	3.2	2.2	2.3	1.6	1.4	1.4	1.5	19	16	6.6
Dibenz(a,h)anthracene	1.1	Trace	Trace	Trace	Trace	Trace	Trace	2.1	1.8	1.1

RDB5 WITHOUT AFTERTREATMENT										
COMPOUNDS[a]	N-A5-T1, ng/bhp-hr			N-A5-T2, ng/bhp-hr			N-A5-T3, ng/bhp-hr			Average Composite, ng/bhp-hr
	Cold	Hot	Composite	Cold	Hot	Composite	Cold	Hot	Composite	
2-Nitrofluorene	ND	ND	ND	6.3	4.3	4.6	ND	ND	ND	1.5
1-Nitropyrene	605	306	349	500	311	338	427	267	290	325
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrochrysene[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	3609	1195	1539	3284	1420	1686	1978	1415	1496	1574
Chrysene	3045	1036	1323	2817	1220	1448	2261	1166	1322	1364
Benzo(b)fluoranthene	3252	586	967	3250	1147	1448	1764	1050	1152	1189
Benzo(k)fluoranthene	967	183	295	970	329	420	714	293	353	356
Benzo(a)pyrene	2917	505	849	3354	1245	1546	1417	1044	1098	1164
Indeno[1,2,3-cd]pyrene	809	72	177	1717	399	587	310	205	220	328
Dibenz(a,h)anthracene	228	37	64	347	88	125	117	88	92	94

[a]Detection limit in ng/bhp-hr calculated using the minimum value that could be quantified by the analytical procedure; if present, the PAH/NPAH was at a concentration less than 0.5 ng/bhp-hr.

[b]ND - None detected at the detection limit

[c]Trace - Value not quantifiable at detection limit; concentration less than twice the detection limit

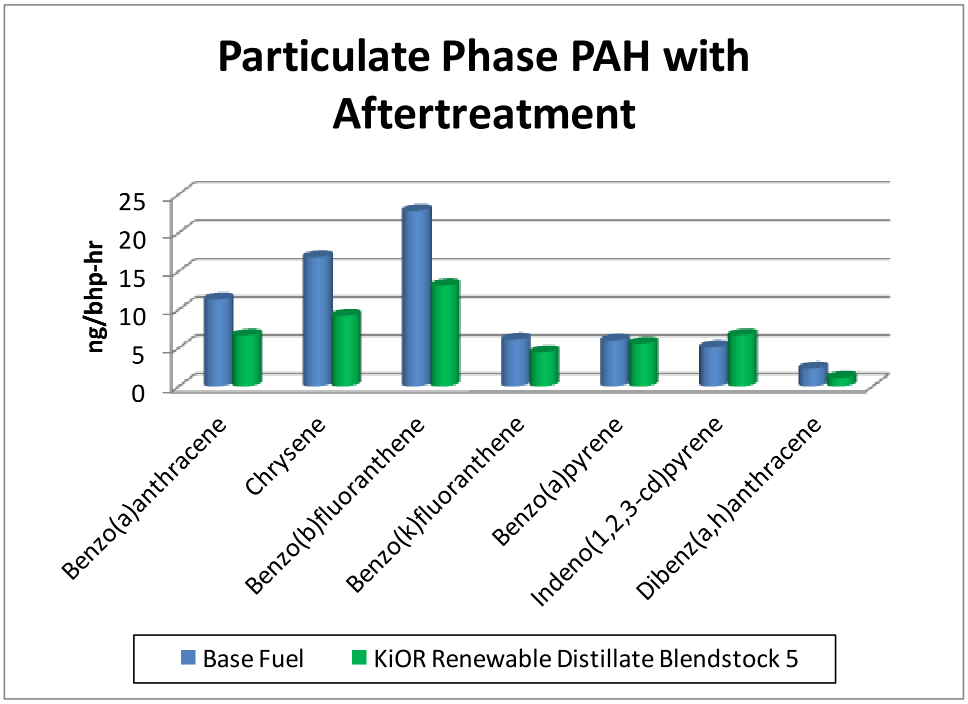


FIGURE 8. PARTICULATE PHASE PAH WITH AFTERTREATMENT

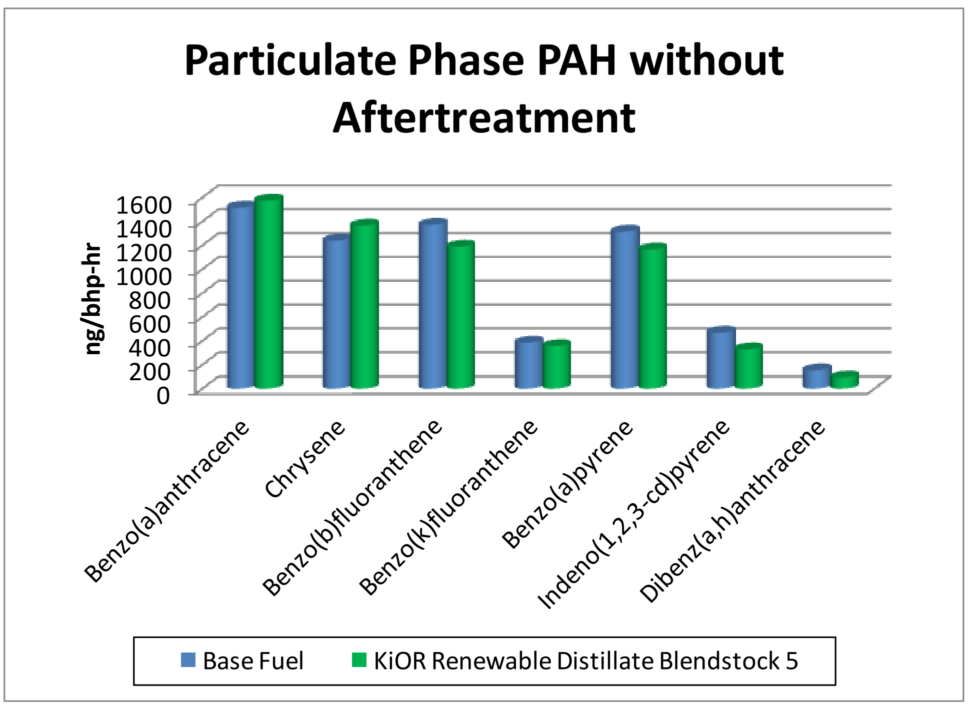


FIGURE 9. PARTICULATE PHASE PAH WITHOUT AFTERTREATMENT

TABLE 8. COMBINED VOLATILE- AND PARTICULATE-PHASE PAH AND NPAH RESULTS

COMPOUND[a]	BASELINE FUEL, ng/bhp-hr			RDB5, ng/bhp-hr		
	Volatile	Particulate	Total	Volatile	Particulate	Total
With Aftertreatment						
2-Nitrofluorene	Trace[c]	Trace	1.1	Trace	Trace	1.0
1-Nitropyrene	Trace	9.2	9.3	Trace	3.6	3.8
7-Nitrobenz(a)anthracene	Trace	Trace	Trace	ND[b]	ND	ND
6-Nitrochrysene	ND	Trace	Trace	ND	ND	ND
6-Nitrobenz(a)pyrene	ND	Trace	Trace	ND	ND	ND
Benzo(a)anthracene	ND	11	11	Trace	6.6	6.7
Chrysene	Trace	17	18	ND	9.2	9.2
Benzo(b)fluoranthene	Trace	23	23	Trace	13	13
Benzo(k)fluoranthene	Trace	6.1	6.5	Trace	4.5	4.6
Benzo(a)pyrene	ND	6.0	6.0	Trace	5.5	6.0
Indeno[1,2,3-cd]pyrene	1.7	5.1	6.8	Trace	6.6	6.8
Dibenz(a,h)anthracene	ND	2.3	2.3	Trace	1.1	1.2
Without Aftertreatment						
2-Nitrofluorene	Trace	2.8	3.2	1.1	1.5	2.6
1-Nitropyrene	Trace	256	256	Trace	325	326
7-Nitrobenz(a)anthracene	ND	ND	ND	ND	ND	ND
6-Nitrochrysene	ND	ND	ND	Trace	ND	Trace
6-Nitrobenz(a)pyrene	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	16	1516	1532	15	1574	1589
Chrysene	33	1239	1272	22	1364	1385
Benzo(b)fluoranthene	46	1372	1418	24	1189	1212
Benzo(k)fluoranthene	14	384	398	14	356	371
Benzo(a)pyrene	27	1314	1342	24	1164	1191
Indeno[1,2,3-cd]pyrene	20	469	489	13	328	341
Dibenz(a,h)anthracene	8.2	154	162	7.4	94	101

[a]Detection limit in ng/bhp-hr calculated using the minimum value that could be quantified by the analytical procedure; if present, the PAH/NPAH was at a concentration less than 0.5 ng/bhp-hr.
[b]ND - None detected at the detection limit.
[c]Trace - Value not quantifiable at detection limit; concentration less than twice the detection limit

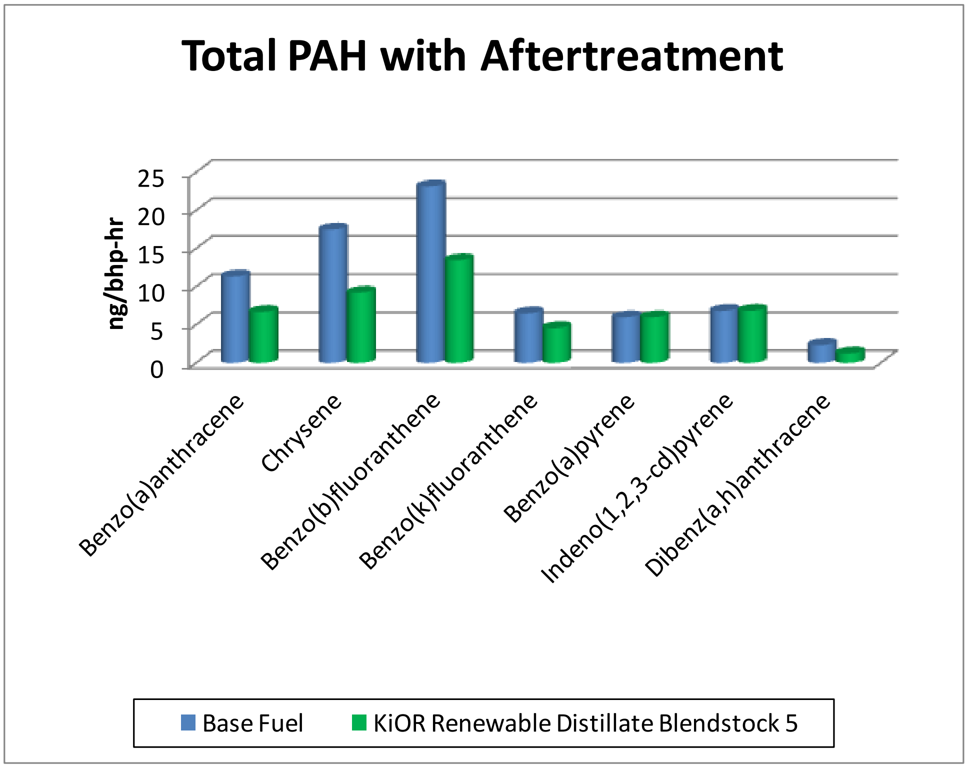


FIGURE 10. TOTAL PAH WITH AFTERTREATMENT

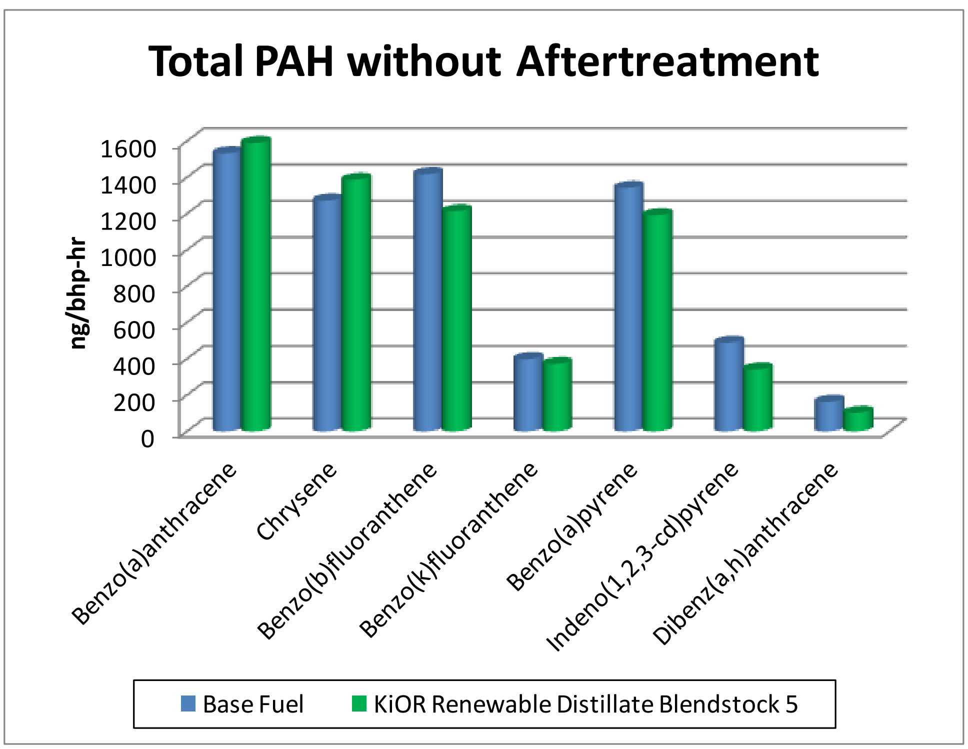


FIGURE 11. TOTAL PAH WITHOUT AFTERTREATMENT

5.0 SUMMARY

Testing was performed on a heavy-duty engine to provide KiOR, Inc. with data to address EPA requirements for registration of a designated F/FA as stipulated by section 211 (b) and 211 (e) of the CAA. A 2011 6.7L Ford Diesel engine was tested according to procedures established in 40 CFR 79.57 and 40 CFR 86 Subpart N. Emissions characterization was performed on the engine after 125 hours of operation with the base diesel fuel and with RDB5, a 5 percent blend of a KiOR Distillate with the base diesel.

With aftertreatment, both fuels were able to meet the 2011 emissions standards. In this case, the NO_x emissions were more than 70 percent lower with both the base fuel and with RDB5 than the corresponding standard, and all of the other emissions were significantly lower than the standard. When the composite emissions for RDB5 with aftertreatment were compared to the corresponding composite emissions from the baseline fuel, RDB5 was found to produce regulated emission levels which were 0.006 g/bhp-hr lower for NMHC, 0.01 g/bhp-hr higher for NO_x, and the same for CO and particulate. Similar trends were also observed when making comparisons to the base fuel without aftertreatment. In this case, the NO_x emissions increased by about 1 percent, the particulate emissions increased by about 3 percent, and the NMHC decreased by 7 percent. The CO emissions were the same for both the base fuel and RDB5.

In general, regulated emissions were higher with the aftertreatment disabled. The engine was able to meet the 2011 emission standards for both fuels when the aftertreatment was in place; but without aftertreatment, the NO_x and particulate emissions were not able to meet the standards for either fuel. These higher levels of NO_x and particulate emissions without aftertreatment were not unexpected because aftertreatment is necessary for the engine to meet these standards.

Speciation of the C_1 to C_{12} hydrocarbons, aldehydes, and ketones was performed during each cold- and hot-segment of the EPA transient cycle. In general,

- All compounds measured in the exhaust with aftertreatment were also present in the exhaust without aftertreatment
- Conversely, a number of additional compounds were found in the exhaust at or above the detection without aftertreatment that were not found with aftertreatment.
- Concentrations were lower with aftertreatment than without.
- All compounds measured in the exhaust with RDB5 and with the aftertreatment in place were present with base fuel with aftertreatment
- Thirteen compounds were found with the base fuel and no aftertreatment but were not found with RDB5 and no aftertreatment.
- Two compounds (2-methyl-2-pentene and 2,2,3-trimethylpentane) were found with RDB5 and no aftertreatment but were not found with the base fuel and no aftertreatment.

- Speciated emission profiles were substantially similar for both fuels
- No additional compounds were detected with KiOR candidate fuel with aftertreatment.

While some C_1 to C_{12} hydrocarbons were below the detection limit, one cannot necessarily conclude that these compounds were present or not present; however if present, the compounds were below the limits of detection.

Volatile- and particulate-phase PAH and NPAH compounds were determined for each test condition. Individual compounds included: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, 7-nitrobenzo[a]anthracene, 6-nitrobenzo[a]pyrene, 6-nitrochrysene, 2-nitrofluorene, and 1-nitropyrene. In general, exhaust PAH and NPAH concentrations without aftertreatment were higher than with aftertreatment, and the particulate-phase PAH and NPAH were higher than the volatile-phase compounds. As a result, the aftertreatment was capable of removing the majority of the PAH and NPAH because these compounds were found mostly in the particulate-phase. Although the concentrations varied between the base fuel and RDB5, no additional PAH or NPAH compounds were detected with KiOR Renewable Diesel Blendstock 5.

6.0 REFERENCES

1. DEER SwRI TIP 06-001, "Traceability to Standards."

2. DEER SwRI TIP 06-002, "NO_x Converter Efficiency Determination."

3. DEER SwRI TIP 06-003, "Linearity Verification of Gas Dividers."

4. DEER SwRI TIP 06-010, "Barometric Pressure Verification."

5. DEER SwRI TIP 06-011, "Propane Recovery Check."

6. DEER SwRI TIP 06-013, "Temperature Calibration and Verification."

7. DEER SwRI TIP 06-016, "Wet CO_2 Interference Check for CO Analyzers."

8. DEER SwRI TIP 06-020, "Pressure Calibration and Verification."

9. DEER SwRI TIP 06-022, "CVS Blower Calibration."

10. DEER SwRI TIP 06-023, "Calibration of Analyzers Using Digital Readout."

11. DEER SwRI TIP 07-023, "Operation of Bag Cart."

12. DEER SwRI TIP 07C-002, "Methane Quantitative Analysis."

13. DEER SwRI TIP 07C-006, "Analysis of Aldehydes and Ketones in Exhaust by Liquid Chromatography."

14. DEER SwRI TIP 07C-018, "Cartridge Sampling of Exhaust Emissions."

15. DEER SwRI TIP 07C-011, "Preparation of Impingers Used in Collection of Unregulated Emissions."

16. DEER SwRI TIP 07C-013, "Hydrocarbon Speciation."

17. DEER SwRI SOP-4.16, "Quality Records."

APPENDIX A

HEAVY-DUTY EMISSION TEST RESULTS

PAGE	TEST NO.	PAGE	TEST NO.
211b Baseline Fuel		KiOR Renewable Diesel Blendstock 5 (RDB5)	
A-1	C-BA-C1-886	A-19	C-A5-C1-951
A-2	C-BA-H1-887	A-20	C-A5-H1-952
A-3	C-BA-C1-886 / C-BA-H1-887 Composite	A-21	C-A5-C1-951 / C-A5-H1-952 Composite
A-4	C-BA-C2-890	A-22	C-A5-C2-957
A-5	C-BA-H2-891	A-23	C-A5-H2-958
A-6	C-BA-C2-890 / C-BA-H2-891 Composite	A-24	C-A5-C2-957 / C-A5-H2-958 Composite
A-7	C-BA-C3-895	A-25	C-A5-C3-964
A-8	C-BA-H3-896	A-26	C-A5-H3-965
A-9	C-BA-C3-895 / C-BA-H3-896 Composite	A-27	C-A5-C3-964 / C-A5-H3-965 Composite
A-10	N-BA-C1-900	A-28	N-A5-C1-969
A-11	N-BA-H1-901	A-29	N-A5-H1-970
A-12	N-BA-C1-900 / N-BA-H1-901 Composite	A-30	N-A5-C1-969 / N-A5-H1-970 Composite
A-13	N-BA-C2-907	A-31	N-A5-C2-972
A-14	N-BA-H2-908	A-32	N-A5-H2-973
A-15	N-BA-C2-907 / N-BA-H2-908 Composite	A-33	N-A5-C2-972 / N-A5-H2-973 Composite
A-16	N-BA-C3-912	A-34	N-A5-C3-975
A-17	N-BA-H3-913	A-35	N-A5-H3-976
A-18	N-BA-C3-912 / N-BA-H3-913 Composite	A-36	N-A5-C3-975 / N-A5-H3-976 Composite

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER	KR4333	TEST KR33-C-A0-T2	GASOLINE EM-7734-F
VEHICLE MODEL	2011 TOYOTA CAMRY	DATE 12/15/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE	2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION	A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER	4123 MILES (6633 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.98 IN HG (736.1 MM HG) DRY BULB TEMPERATURE 72.0°F (22.2°C) NOX HUMIDITY C.F. 1.044

RELATIVE HUMIDITY 69.1 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.0	868.3	505.1	868.5
DRY/WET CORRECTION FACTOR, SAMP/BACK	.972/.981	.975/.981	.973/.981	.975/.981
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.86 (6.21)	3.59 (5.78)	3.88 (6.24)
BLOWER FLOW RATE SCFM (SCMM)	279.9 (7.93)	276.9 (7.84)	277.3 (7.85)	278.0 (7.87)
20X20 FLOW RATE SCFM (SCMM)	45.6 (1.29)	45.7 (1.29)	46.7 (1.32)	46.6 (1.32)
GAS METER FLOW RATE SCFM (SCMM)	.84 (.02)	.81 (.02)	.85 (.02)	.81 (.02)
TOTAL FLOW SCF (SCM)	2746. (77.8)	4680. (132.5)	2734. (77.4)	4709. (133.4)
HC SAMPLE METER/RANGE/PPM (BAG)	10.9/ 2/ 10.90	3.6/ 2/ 3.60	3.5/ 2/ 3.50	3.2/ 2/ 3.20
HC BCKGRD METER/RANGE/PPM	3.5/ 2/ 3.50	3.5/ 2/ 3.50	3.2/ 2/ 3.20	3.1/ 2/ 3.10
CO SAMPLE METER/RANGE/PPM	23.9/ 12/ 23.04	.2/ 12/ .20	.7/ 12/ .69	.2/ 12/ .20
CO BCKGRD METER/RANGE/PPM	.1/ 12/ .10	.2/ 12/ .20	.1/ 12/ .10	.5/ 12/ .49
CO2 SAMPLE METER/RANGE/PCT	54.0/ 1/ .9839	73.1/ 11/ .6209	88.0/ 11/ .8378	71.2/ 11/ .5961
CO2 BCKGRD METER/RANGE/PCT	3.2/ 1/ .0525	9.4/ 11/ .0543	9.7/ 11/ .0561	9.7/ 11/ .0561
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	5.3/ 1/ 1.33	1.0/ 1/ .25	2.4/ 1/ .60	1.1/ 1/ .28
NOX BCKGRD METER/RANGE/PPM	.3/ 1/ .08	.3/ 1/ .08	.3/ 1/ .08	.3/ 1/ .08
CH4 SAMPLE PPM (1.155)	3.15	2.16	2.25	2.16
CH4 BCKGRD PPM	2.19	2.21	2.22	2.21
DILUTION FACTOR	13.66	21.71	16.09	22.61
HC CONCENTRATION PPM	7.66	.26	.50	.24
CO CONCENTRATION PPM	22.00	.01	.57	-.27
CO2 CONCENTRATION PCT	.9353	.5690	.7851	.5424
NOX CONCENTRATION PPM	1.26	.18	.53	.20
CH4 CONCENTRATION PPM	1.12	.04	.17	.04
NMHC CONCENTRATION PPM	6.36	.21	.30	.19
HC MASS GRAMS	.343	.020	.022	.018
CO MASS GRAMS	1.992	.001	.052	.000
CO2 MASS GRAMS	1331.69	1380.67	1113.04	1324.44
NOX MASS GRAMS	.195	.047	.082	.054
PM MASS MILLIGRAMS	5.9	2.9	1.9	.0
CH4 MASS GRAMS	.058	.004	.009	.004
NMHC MASS GRAMS (FID)	.285	.016	.013	.014
FUEL MASS KG	.421	.435	.351	.418
FUEL ECONOMY MPG (L/100KM)	24.00 (9.80)	24.90 (9.45)	28.72 (8.19)	26.09 (9.02)

4-BAG COMPOSITE RESULTS

HC	G/MI	.024	CH4	G/MI	.005
CO	G/MI	.119	NMHC	G/MI	.019
NOX	G/MI	.024			
PM	MG/MI	.7			

FUEL ECONOMY MPG (L/100KM) 26.07 (9.02)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-C-A0-T2	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 12/15/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4123 MILES (6633 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.98 IN HG (736.1 MM HG) DRY BULB TEMPERATURE 72.0°F (22.2°C) NOX HUMIDITY C.F. 1.044
RELATIVE HUMIDITY 69.1 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30635		30636		30637		30638	
FILTER WEIGHT GAINS (MG)	.015	.000	.007	.000	.005	.000	.000	.000
FILTER EFFICIENCY	*****		*****		*****		.00	
SAMPLE MULTIPLIER	.390		.398		.382		.000	
TOTAL WEIGHT GAIN (MG)	.015		.007		.005		.000	
PARTICULATE MASS (MG)	5.9		2.9		1.9		.0	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-C-A0-T3	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 12/16/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4138 MILES (6658 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.99 IN HG (736.3 MM HG) DRY BULB TEMPERATURE 72.1°F (22.3°C) NOX HUMIDITY C.F. 1.043

RELATIVE HUMIDITY 68.7 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	504.9	867.7	506.4	867.8
DRY/WET CORRECTION FACTOR, SAMP/BACK	.972/.981	.975/.981	.973/.981	.975/.981
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.88 (6.24)	3.60 (5.79)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	279.3 (7.91)	277.9 (7.87)	278.3 (7.88)	279.7 (7.92)
20X20 FLOW RATE SCFM (SCMM)	45.4 (1.29)	45.5 (1.29)	46.7 (1.32)	46.6 (1.32)
GAS METER FLOW RATE SCFM (SCMM)	.85 (.02)	.83 (.02)	.85 (.02)	.81 (.02)
TOTAL FLOW SCF (SCM)	2740. (77.6)	4688. (132.8)	2750. (77.9)	4731. (134.0)
HC SAMPLE METER/RANGE/PPM (BAG)	9.1/ 2/ 9.10	3.5/ 2/ 3.50	3.8/ 2/ 3.80	4.8/ 2/ 4.80
HC BCKGRD METER/RANGE/PPM	3.4/ 2/ 3.40	3.4/ 2/ 3.40	3.3/ 2/ 3.30	3.6/ 2/ 3.60
CO SAMPLE METER/RANGE/PPM	20.0/ 12/ 19.30	.3/ 12/ .30	.9/ 12/ .89	.5/ 12/ .49
CO BCKGRD METER/RANGE/PPM	.1/ 12/ .10	.1/ 12/ .10	.1/ 12/ .10	.3/ 12/ .30
CO2 SAMPLE METER/RANGE/PCT	54.4/ 1/ .9920	73.4/ 11/ .6248	87.4/ 11/ .8283	71.3/ 11/ .5974
CO2 BCKGRD METER/RANGE/PCT	2.8/ 1/ .0459	9.1/ 11/ .0525	9.2/ 11/ .0531	9.2/ 11/ .0531
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	7.1/ 1/ 1.78	1.1/ 1/ .28	2.6/ 1/ .65	1.3/ 1/ .33
NOX BCKGRD METER/RANGE/PPM	.2/ 1/ .05	.3/ 1/ .08	.3/ 1/ .08	.2/ 1/ .05
CH4 SAMPLE PPM (1.155)	2.80	2.02	2.21	2.09
CH4 BCKGRD PPM	2.07	2.03	2.13	2.16
DILUTION FACTOR	13.56	21.57	16.27	22.56
HC CONCENTRATION PPM	5.95	.26	.70	1.36
CO CONCENTRATION PPM	18.42	.19	.76	.20
CO2 CONCENTRATION PCT	.9495	.5747	.7784	.5466
NOX CONCENTRATION PPM	1.73	.20	.58	.28
CH4 CONCENTRATION PPM	.88	.09	.20	.02
NMHC CONCENTRATION PPM	4.93	.16	.47	1.33
HC MASS GRAMS	.266	.020	.032	.105
CO MASS GRAMS	1.664	.030	.069	.031
CO2 MASS GRAMS	1348.84	1397.07	1109.88	1340.74
NOX MASS GRAMS	.268	.054	.090	.074
PM MASS MILLIGRAMS	5.7	2.3	.3	1.1
CH4 MASS GRAMS	.046	.008	.011	.002
NMHC MASS GRAMS (FID)	.221	.012	.021	.103
FUEL MASS KG	.426	.440	.350	.423
FUEL ECONOMY MPG (L/100KM)	23.64 (9.95)	24.73 (9.51)	28.88 (8.15)	25.70 (9.15)

4-BAG COMPOSITE RESULTS

HC	G/MI	.027	CH4	G/MI	.004
CO	G/MI	.105	NMHC	G/MI	.023
NOX	G/MI	.031			
PM	MG/MI	.6			

FUEL ECONOMY MPG (L/100KM) 25.87 (9.09)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-C-A0-T3	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 12/16/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4138 MILES (6658 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.99 IN HG (736.3 MM HG) DRY BULB TEMPERATURE 72.1°F (22.3°C) NOX HUMIDITY C.F. 1.043

RELATIVE HUMIDITY 68.7 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30639		30640		30641		30638	
FILTER WEIGHT GAINS (MG)	.015	.000	.006	.000	.001	.000	.003	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.381		.391		.385		.403	
TOTAL WEIGHT GAIN (MG)	.015		.006		.001		.003	
PARTICULATE MASS (MG)	5.7		2.3		.3		1.1	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-C-A0-T4	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 12/17/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4152 MILES (6680 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.16 IN HG (740.7 MM HG)   DRY BULB TEMPERATURE 72.0°F (22.2°C)   NOX HUMIDITY C.F. .993

RELATIVE HUMIDITY 61.0 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.1	868.0	504.5	868.2
DRY/WET CORRECTION FACTOR, SAMP/BACK	.974/.983	.978/.983	.976/.983	.978/.983
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.88 (6.24)	3.60 (5.79)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	280.1 (7.93)	278.6 (7.89)	281.3 (7.97)	279.1 (7.90)
20X20 FLOW RATE SCFM (SCMM)	46.6 (1.32)	46.4 (1.32)	46.3 (1.31)	46.3 (1.31)
GAS METER FLOW RATE SCFM (SCMM)	.85 (.02)	.83 (.02)	.85 (.02)	.83 (.02)
TOTAL FLOW SCF (SCM)	2758. (78.1)	4714. (133.5)	2762. (78.2)	4720. (133.7)
HC SAMPLE METER/RANGE/PPM (BAG)	8.4/ 2/ 8.40	3.3/ 2/ 3.30	3.5/ 2/ 3.50	3.0/ 2/ 3.00
HC BCKGRD METER/RANGE/PPM	3.4/ 2/ 3.40	3.2/ 2/ 3.20	3.0/ 2/ 3.00	2.9/ 2/ 2.90
CO SAMPLE METER/RANGE/PPM	16.1/ 12/ 15.57	.3/ 12/ .30	.9/ 12/ .89	.4/ 12/ .39
CO BCKGRD METER/RANGE/PPM	.2/ 12/ .20	.1/ 12/ .10	.2/ 12/ .20	.3/ 12/ .30
CO2 SAMPLE METER/RANGE/PCT	53.7/ 1/ .9778	72.3/ 11/ .6103	87.8/ 11/ .8346	70.5/ 11/ .5871
CO2 BCKGRD METER/RANGE/PCT	3.1/ 1/ .0508	9.0/ 11/ .0519	9.3/ 11/ .0537	9.1/ 11/ .0525
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	7.8/ 1/ 1.95	1.0/ 1/ .25	2.2/ 1/ .55	1.2/ 1/ .30
NOX BCKGRD METER/RANGE/PPM	.4/ 1/ .10	.3/ 1/ .08	.3/ 1/ .08	.3/ 1/ .08
CH4 SAMPLE PPM (1.155)	2.69	2.00	2.12	1.99
CH4 BCKGRD PPM	2.04	2.03	2.04	2.04
DILUTION FACTOR	13.76	22.08	16.15	22.96
HC CONCENTRATION PPM	5.25	.24	.69	.23
CO CONCENTRATION PPM	14.79	.19	.67	.10
CO2 CONCENTRATION PCT	.9307	.5608	.7842	.5368
NOX CONCENTRATION PPM	1.86	.18	.48	.23
CH4 CONCENTRATION PPM	.79	.06	.20	.04
NMHC CONCENTRATION PPM	4.33	.18	.45	.19
HC MASS GRAMS	.236	.019	.031	.017
CO MASS GRAMS	1.345	.030	.061	.016
CO2 MASS GRAMS	1330.83	1370.53	1123.21	1313.92
NOX MASS GRAMS	.276	.045	.071	.058
PM MASS MILLIGRAMS	2.5	.0	.8	1.1
CH4 MASS GRAMS	.041	.005	.011	.003
NMHC MASS GRAMS (FID)	.195	.014	.020	.014
FUEL MASS KG	.420	.432	.354	.414
FUEL ECONOMY MPG (L/100KM)	24.04 (9.79)	25.21 (9.33)	28.54 (8.24)	26.23 (8.97)

4-BAG COMPOSITE RESULTS

HC	G/MI	.018	CH4	G/MI	.004
CO	G/MI	.085	NMHC	G/MI	.015
NOX	G/MI	.028			
PM	MG/MI	.3			

FUEL ECONOMY MPG (L/100KM) 26.15 (9.00)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-C-A0-T4	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 12/17/2010 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-V6	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4152 MILES (6680 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.16 IN HG (740.7 MM HG)   DRY BULB TEMPERATURE 72.0°F (22.2°C)   NOX HUMIDITY C.F. .993

RELATIVE HUMIDITY 61.0 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30643		30644		30645		30646	
FILTER WEIGHT GAINS (MG)	.007	.000	.000	.000	.002	.000	.003	.000
FILTER EFFICIENCY	*****		.00		*****		*****	
SAMPLE MULTIPLIER	.385		.000		.385		.393	
TOTAL WEIGHT GAIN (MG)	.007		.000		.002		.003	
PARTICULATE MASS (MG)	2.5		.0		.8		1.1	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-N-A0-T1	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 1/ 4/2011 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4200 MILES (6757 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.17 IN HG (740.9 MM HG) DRY BULB TEMPERATURE 71.2°F (21.8°C) NOX HUMIDITY C.F. .999

RELATIVE HUMIDITY 63.8 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT	STABILIZED	HOT TRANSIENT	HOT STABILIZED
	(0-505 SEC.)	(505-1372 SEC.)	(0- 505 SEC.)	(505-1372 SEC.)
RUN TIME SECONDS	505.1	868.2	504.9	868.3
DRY/WET CORRECTION FACTOR, SAMP/BACK	.974/.983	.978/.983	.976/.983	.978/.983
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.86 (6.21)	3.59 (5.78)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	280.5 (7.94)	279.5 (7.92)	280.4 (7.94)	280.4 (7.94)
20X20 FLOW RATE SCFM (SCMM)	46.2 (1.31)	46.2 (1.31)	47.0 (1.33)	47.0 (1.33)
GAS METER FLOW RATE SCFM (SCMM)	.85 (.02)	.83 (.02)	.86 (.02)	.83 (.02)
TOTAL FLOW SCF (SCM)	2757. (78.1)	4726. (133.8)	2762. (78.2)	4749. (134.5)
HC SAMPLE METER/RANGE/PPM (BAG)	12.6/ 3/ 126.48	88.2/ 2/ 88.22	10.0/ 3/ 100.38	86.7/ 2/ 86.72
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	3.8/ 2/ 3.80	.4/ 3/ 4.02	3.8/ 2/ 3.80
CO SAMPLE METER/RANGE/PPM	56.8/ 1/ 552.68	75.7/ 14/ 364.45	47.7/ 1/ 459.92	75.3/ 14/ 362.25
CO BCKGRD METER/RANGE/PPM	.0/ 1/ .00	.2/ 14/ .83	.1/ 1/ .93	.1/ 14/ .42
CO2 SAMPLE METER/RANGE/PCT	93.9/ 11/ .9345	69.0/ 11/ .5681	83.3/ 11/ .7651	67.4/ 11/ .5483
CO2 BCKGRD METER/RANGE/PCT	9.1/ 11/ .0525	9.1/ 11/ .0525	9.5/ 11/ .0549	9.5/ 11/ .0549
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	38.1/ 3/ 95.25	47.9/ 2/ 48.11	92.3/ 2/ 92.41	49.2/ 2/ 49.40
NOX BCKGRD METER/RANGE/PPM	.0/ 3/ .00	.1/ 2/ .10	.2/ 2/ .21	.2/ 2/ .21
CH4 SAMPLE PPM (1.160)	5.49	4.35	4.73	4.34
CH4 BCKGRD PPM	2.10	2.12	2.20	2.12
DILUTION FACTOR	13.48	22.03	16.46	22.78
HC CONCENTRATION PPM	122.76	84.59	96.61	83.09
CO CONCENTRATION PPM	531.38	352.18	442.83	350.59
CO2 CONCENTRATION PCT	.8858	.5180	.7135	.4958
NOX CONCENTRATION PPM	95.25	48.01	92.22	49.20
CH4 CONCENTRATION PPM	3.54	2.32	2.66	2.30
NMHC CONCENTRATION PPM	118.65	81.90	93.52	80.41
HC MASS GRAMS	5.526	6.526	4.356	6.441
CO MASS GRAMS	48.309	54.872	40.330	54.893
CO2 MASS GRAMS	1266.51	1269.20	1021.83	1220.89
NOX MASS GRAMS	14.214	12.278	13.786	12.645
PM MASS MILLIGRAMS	12.0	5.5	10.1	7.1
CH4 MASS GRAMS	.184	.207	.139	.207
NMHC MASS GRAMS (FID)	5.341	6.318	4.217	6.234
FUEL MASS KG	.429	.434	.346	.419
FUEL ECONOMY MPG (L/100KM)	23.51 (10.01)	24.98 (9.42)	29.09 (8.09)	25.96 (9.06)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.521	CH4	G/MI	.049
CO	G/MI	13.232	NMHC	G/MI	1.472
NOX	G/MI	3.549			
PM	MG/MI	2.3			

FUEL ECONOMY MPG (L/100KM) 26.03 (9.04)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-N-A0-T1	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 1/ 4/2011 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4200 MILES (6757 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.17 IN HG (740.9 MM HG) DRY BULB TEMPERATURE 71.2°F (21.8°C) NOX HUMIDITY C.F. .999
RELATIVE HUMIDITY 63.8 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30651		30652		30653		30654	
FILTER WEIGHT GAINS (MG)	.031	.000	.014	.000	.026	.000	.018	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.384		.396		.384		.396	
TOTAL WEIGHT GAIN (MG)	.031		.014		.026		.018	
PARTICULATE MASS (MG)	12.0		5.5		10.1		7.1	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-N-A0-T2	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 1/ 5/2011 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4214 MILES (6780 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.12 IN HG (739.6 MM HG)   DRY BULB TEMPERATURE 71.4°F (21.9°C)   NOX HUMIDITY C.F. 1.047

RELATIVE HUMIDITY 71.3 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.0	868.1	505.0	867.9
DRY/WET CORRECTION FACTOR, SAMP/BACK	.972/.981	.976/.981	.974/.981	.976/.981
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.87 (6.23)	3.59 (5.78)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	279.3 (7.91)	278.7 (7.89)	280.2 (7.93)	280.8 (7.95)
20X20 FLOW RATE SCFM (SCMM)	47.2 (1.34)	46.7 (1.32)	47.0 (1.33)	46.9 (1.33)
GAS METER FLOW RATE SCFM (SCMM)	.85 (.02)	.84 (.02)	.85 (.02)	.82 (.02)
TOTAL FLOW SCF (SCM)	2755. (78.0)	4719. (133.7)	2761. (78.2)	4752. (134.6)
HC SAMPLE METER/RANGE/PPM (BAG)	12.8/ 3/ 128.49	88.0/ 2/ 88.02	10.1/ 3/ 101.38	86.9/ 2/ 86.92
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	3.8/ 2/ 3.80	.4/ 3/ 4.02	3.6/ 2/ 3.60
CO SAMPLE METER/RANGE/PPM	56.8/ 1/ 552.68	71.4/ 14/ 341.03	90.1/ 14/ 445.22	70.9/ 14/ 338.33
CO BCKGRD METER/RANGE/PPM	.2/ 1/ 1.85	.1/ 14/ .42	.1/ 14/ .42	.1/ 14/ .42
CO2 SAMPLE METER/RANGE/PCT	50.8/ 1/ .9197	68.9/ 11/ .5669	83.2/ 11/ .7635	67.3/ 11/ .5471
CO2 BCKGRD METER/RANGE/PCT	2.9/ 1/ .0475	9.0/ 11/ .0519	9.1/ 11/ .0525	9.2/ 11/ .0531
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	37.1/ 3/ 92.75	47.5/ 2/ 47.71	90.6/ 2/ 90.70	48.1/ 2/ 48.30
NOX BCKGRD METER/RANGE/PPM	.1/ 3/ .25	.3/ 2/ .31	.2/ 2/ .21	.3/ 2/ .31
CH4 SAMPLE PPM (1.160)	5.36	4.18	4.49	4.20
CH4 BCKGRD PPM	1.97	1.98	1.98	1.97
DILUTION FACTOR	13.68	22.16	16.52	22.92
HC CONCENTRATION PPM	124.77	84.39	97.61	83.48
CO CONCENTRATION PPM	528.51	329.08	428.05	326.59
CO2 CONCENTRATION PCT	.8757	.5173	.7142	.4963
NOX CONCENTRATION PPM	92.51	47.41	90.50	48.01
CH4 CONCENTRATION PPM	3.53	2.29	2.63	2.31
NMHC CONCENTRATION PPM	120.67	81.73	94.56	80.80
HC MASS GRAMS	5.612	6.502	4.399	6.476
CO MASS GRAMS	48.011	51.203	38.964	51.172
CO2 MASS GRAMS	1251.02	1265.79	1022.36	1222.94
NOX MASS GRAMS	14.456	12.690	14.170	12.939
PM MASS MILLIGRAMS	11.4	6.7	7.6	9.0
CH4 MASS GRAMS	.184	.204	.137	.207
NMHC MASS GRAMS (FID)	5.427	6.297	4.262	6.268
FUEL MASS KG	.424	.431	.346	.417
FUEL ECONOMY MPG (L/100KM)	23.78 (9.89)	25.21 (9.33)	29.13 (8.08)	26.03 (9.04)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.529	CH4	G/MI	.049
CO	G/MI	12.607	NMHC	G/MI	1.480
NOX	G/MI	3.636			
PM	MG/MI	2.3			

FUEL ECONOMY MPG (L/100KM) 26.17 (8.99)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-N-A0-T2	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 1/ 5/2011 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4214 MILES (6780 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.12 IN HG (739.6 MM HG) DRY BULB TEMPERATURE 71.4°F (21.9°C) NOX HUMIDITY C.F. 1.047

RELATIVE HUMIDITY 71.3 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30655		30656		30657		30658	
FILTER WEIGHT GAINS (MG)	.030	.000	.017	.000	.020	.000	.023	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.385		.391		.386		.400	
TOTAL WEIGHT GAIN (MG)	.030		.017		.020		.023	
PARTICULATE MASS (MG)	11.4		6.7		7.6		9.0	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST KR33-N-A0-T3	GASOLINE EM-7734-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 1/ 6/2011 RUN	FUEL DENSITY 6.189 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 4229 MILES (6804 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.22 IN HG (742.2 MM HG)   DRY BULB TEMPERATURE 70.8°F (21.6°C)   NOX HUMIDITY C.F. .980

RELATIVE HUMIDITY 61.1 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT	STABILIZED	HOT TRANSIENT	HOT STABILIZED
	(0-505 SEC.)	(505-1372 SEC.)	(0- 505 SEC.)	(505-1372 SEC.)
RUN TIME SECONDS	505.0	868.0	504.9	868.1
DRY/WET CORRECTION FACTOR, SAMP/BACK	.976/.984	.979/.984	.977/.984	.979/.984
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.86 (6.21)	3.59 (5.78)	3.86 (6.21)
BLOWER FLOW RATE SCFM (SCMM)	281.2 (7.96)	280.3 (7.94)	280.9 (7.96)	280.7 (7.95)
20X20 FLOW RATE SCFM (SCMM)	47.5 (1.35)	47.3 (1.34)	47.5 (1.35)	47.5 (1.34)
GAS METER FLOW RATE SCFM (SCMM)	.86 (.02)	.84 (.02)	.85 (.02)	.84 (.02)
TOTAL FLOW SCF (SCM)	2774. (78.6)	4751. (134.6)	2771. (78.5)	4761. (134.8)
HC SAMPLE METER/RANGE/PPM (BAG)	12.5/ 3/ 125.48	88.4/ 2/ 88.42	10.1/ 3/ 101.38	86.2/ 2/ 86.22
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	3.7/ 2/ 3.70	.4/ 3/ 4.02	3.5/ 2/ 3.50
CO SAMPLE METER/RANGE/PPM	56.9/ 1/ 553.71	72.9/ 14/ 349.16	91.0/ 14/ 450.39	70.6/ 14/ 336.71
CO BCKGRD METER/RANGE/PPM	.1/ 1/ .93	.1/ 14/ .42	.2/ 14/ .83	.2/ 14/ .83
CO2 SAMPLE METER/RANGE/PCT	50.1/ 1/ .9058	68.8/ 11/ .5656	83.0/ 11/ .7605	67.2/ 11/ .5459
CO2 BCKGRD METER/RANGE/PCT	3.1/ 1/ .0508	9.0/ 11/ .0519	9.6/ 11/ .0555	9.5/ 11/ .0549
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	38.0/ 3/ 95.00	48.1/ 2/ 48.30	91.2/ 2/ 91.30	48.1/ 2/ 48.30
NOX BCKGRD METER/RANGE/PPM	.1/ 3/ .25	.1/ 2/ .10	.3/ 2/ .31	.3/ 2/ .31
CH4 SAMPLE PPM (1.160)	5.45	4.35	4.72	4.07
CH4 BCKGRD PPM	2.14	2.12	2.07	2.06
DILUTION FACTOR	13.88	22.17	16.57	22.97
HC CONCENTRATION PPM	121.75	84.89	97.61	82.87
CO CONCENTRATION PPM	532.30	338.08	434.15	325.75
CO2 CONCENTRATION PCT	.8586	.5160	.7084	.4934
NOX CONCENTRATION PPM	94.76	48.21	91.01	48.01
CH4 CONCENTRATION PPM	3.46	2.33	2.77	2.10
NMHC CONCENTRATION PPM	117.73	82.19	94.40	80.44
HC MASS GRAMS	5.513	6.584	4.416	6.440
CO MASS GRAMS	48.681	52.959	39.670	51.128
CO2 MASS GRAMS	1234.94	1271.25	1017.90	1217.78
NOX MASS GRAMS	13.947	12.152	13.383	12.126
PM MASS MILLIGRAMS	11.2	10.2	11.1	7.9
CH4 MASS GRAMS	.181	.209	.145	.188
NMHC MASS GRAMS (FID)	5.331	6.375	4.271	6.251
FUEL MASS KG	.419	.434	.345	.416
FUEL ECONOMY MPG (L/100KM)	24.06 (9.78)	24.99 (9.41)	29.21 (8.05)	26.07 (9.02)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.529	CH4	G/MI	.048
CO	G/MI	12.814	NMHC	G/MI	1.481
NOX	G/MI	3.458			
PM	MG/MI	2.7			

FUEL ECONOMY MPG (L/100KM) 26.22 (8.97)

SOUTHWEST RESEARCH INSTITUTE · DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333
VEHICLE MODEL 2011 TOYOTA CAMRY
ENGINE 2.5 L (153 CID)-4
TRANSMISSION A
ODOMETER 4229 MILES (6804 KM)

TEST KR33-N-A0-T3
DATE 1/ 6/2011 RUN
DYNO 3 BAG CART 2
ACTUAL ROAD LOAD 11.00 HP (8.21 KW)
TEST WEIGHT 3625 LBS (1643 KG)

GASOLINE EM-7734-F
FUEL DENSITY 6.189 LB/GAL
H .134 C .866 O .000 X .000
FTP

BAROMETER 29.22 IN HG (742.2 MM HG) DRY BULB TEMPERATURE 70.8°F (21.6°C) NOX HUMIDITY C.F. .980
RELATIVE HUMIDITY 61.1 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	30659		30660		30661		30662	
FILTER WEIGHT GAINS (MG)	.029	.000	.026	.000	.029	.000	.020	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.383		.393		.388		.394	
TOTAL WEIGHT GAIN (MG)	.029		.026		.029		.020	
PARTICULATE MASS (MG)	11.2		10.2		11.1		7.9	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER	KR4333	TEST C-A5-P320-T1	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL	2011 TOYOTA CAMRY	DATE 4/21/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE	2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION	A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER	8252 MILES (13277 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.04 IN HG (737.6 MM HG)   DRY BULB TEMPERATURE 71.1°F (21.7°C)   NOX HUMIDITY C.F. 1.002

RELATIVE HUMIDITY 64.2 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	504.8	868.5	504.6	868.6
DRY/WET CORRECTION FACTOR, SAMP/BACK	.974/.983	.978/.983	.976/.983	.978/.983
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.86 (6.21)	3.60 (5.79)	3.86 (6.21)
BLOWER FLOW RATE SCFM (SCMM)	294.5 (8.34)	293.3 (8.31)	294.7 (8.35)	294.6 (8.34)
20X20 FLOW RATE SCFM (SCMM)	46.3 (1.31)	45.7 (1.29)	47.3 (1.34)	46.5 (1.32)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.81 (.02)	.91 (.03)	.79 (.02)
TOTAL FLOW SCF (SCM)	2875. (81.4)	4919. (139.3)	2884. (81.7)	4949. (140.1)
HC SAMPLE METER/RANGE/PPM (BAG)	12.7/ 2/ 12.70	4.2/ 2/ 4.20	4.2/ 2/ 4.20	4.2/ 2/ 4.20
HC BCKGRD METER/RANGE/PPM	5.0/ 2/ 5.00	4.2/ 2/ 4.20	4.2/ 2/ 4.20	4.2/ 2/ 4.20
CO SAMPLE METER/RANGE/PPM	23.2/ 12/ 22.37	.2/ 12/ .20	.5/ 12/ .49	.1/ 12/ .10
CO BCKGRD METER/RANGE/PPM	.3/ 12/ .30	.2/ 12/ .20	.2/ 12/ .20	.1/ 12/ .10
CO2 SAMPLE METER/RANGE/PCT	52.5/ 1/ .9537	32.1/ 1/ .5599	43.5/ 1/ .7762	31.3/ 1/ .5451
CO2 BCKGRD METER/RANGE/PCT	2.7/ 1/ .0442	2.8/ 1/ .0459	2.8/ 1/ .0459	2.9/ 1/ .0475
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	3.2/ 1/ .80	1.0/ 1/ .25	1.7/ 1/ .43	.9/ 1/ .23
NOX BCKGRD METER/RANGE/PPM	.3/ 1/ .08	.3/ 1/ .08	.3/ 1/ .08	.3/ 1/ .08
CH4 SAMPLE PPM (1.170)	2.56	1.81	1.91	1.80
CH4 BCKGRD PPM	2.01	1.90	1.90	1.89
DILUTION FACTOR	14.10	24.08	17.37	24.73
HC CONCENTRATION PPM	8.06	.17	.24	.17
CO CONCENTRATION PPM	21.22	.01	.29	.00
CO2 CONCENTRATION PCT	.9126	.5159	.7330	.4995
NOX CONCENTRATION PPM	.73	.18	.35	.15
CH4 CONCENTRATION PPM	.70	-.01	.12	-.01
NMHC CONCENTRATION PPM	7.24	.17	.10	.17
HC MASS GRAMS	.378	.014	.011	.014
CO MASS GRAMS	2.012	.001	.028	.000
CO2 MASS GRAMS	1360.52	1315.79	1096.21	1281.58
NOX MASS GRAMS	.114	.048	.055	.041
PM MASS MILLIGRAMS	5.3	3.5	3.3	1.4
CH4 MASS GRAMS	.038	.000	.007	.000
NMHC MASS GRAMS (FID)	.340	.014	.005	.014
FUEL MASS KG	.430	.415	.346	.404
FUEL ECONOMY MPG (L/100KM)	23.57 (9.98)	26.29 (8.95)	29.43 (7.99)	26.99 (8.71)

4-BAG COMPOSITE RESULTS

HC	G/MI	.025	CH4	G/MI	.003
CO	G/MI	.118	NMHC	G/MI	.022
NOX	G/MI	.017			
PM	MG/MI	.9			

FUEL ECONOMY MPG (L/100KM) 26.74 (8.80)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST C-A5-P320-T1	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/21/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8252 MILES (13277 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.04 IN HG (737.6 MM HG) DRY BULB TEMPERATURE 71.1°F (21.7°C) NOX HUMIDITY C.F. 1.002
RELATIVE HUMIDITY 64.2 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32618		32619		32620		32621	
FILTER WEIGHT GAINS (MG)	.014	.000	.008	.000	.009	.000	.003	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.375		.419		.376		.430	
TOTAL WEIGHT GAIN (MG)	.014		.008		.009		.003	
PARTICULATE MASS (MG)	5.3		3.5		3.3		1.4	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST C-A5-P320-T2	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/22/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8266 MILES (13299 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.98 IN HG (736.1 MM HG)   DRY BULB TEMPERATURE 72.2°F (22.3°C)   NOX HUMIDITY C.F. 1.017

RELATIVE HUMIDITY 64.3 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	504.8	868.2	504.7	868.5
DRY/WET CORRECTION FACTOR, SAMP/BACK	.973/.982	.977/.982	.975/.982	.977/.982
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.87 (6.23)	3.59 (5.78)	3.86 (6.21)
BLOWER FLOW RATE SCFM (SCMM)	293.5 (8.31)	294.1 (8.33)	293.1 (8.30)	294.1 (8.33)
20X20 FLOW RATE SCFM (SCMM)	45.8 (1.30)	45.8 (1.30)	47.5 (1.35)	45.9 (1.30)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.80 (.02)	.90 (.03)	.80 (.02)
TOTAL FLOW SCF (SCM)	2863. (81.1)	4930. (139.6)	2873. (81.4)	4933. (139.7)
HC SAMPLE METER/RANGE/PPM (BAG)	12.7/ 2/ 12.70	3.8/ 2/ 3.80	3.6/ 2/ 3.60	3.6/ 2/ 3.60
HC BCKGRD METER/RANGE/PPM	3.8/ 2/ 3.80	3.8/ 2/ 3.80	3.6/ 2/ 3.60	3.6/ 2/ 3.60
CO SAMPLE METER/RANGE/PPM	23.2/ 12/ 22.37	.2/ 12/ .20	.7/ 12/ .69	.1/ 12/ .10
CO BCKGRD METER/RANGE/PPM	.3/ 12/ .30	.2/ 12/ .20	.2/ 12/ .20	.1/ 12/ .10
CO2 SAMPLE METER/RANGE/PCT	52.6/ 1/ .9557	32.8/ 1/ .5729	44.0/ 1/ .7859	32.0/ 1/ .5580
CO2 BCKGRD METER/RANGE/PCT	2.7/ 1/ .0442	2.7/ 1/ .0442	2.9/ 1/ .0475	2.9/ 1/ .0475
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	6.6/ 1/ 1.65	1.1/ 1/ .28	2.1/ 1/ .53	1.4/ 1/ .35
NOX BCKGRD METER/RANGE/PPM	.3/ 1/ .08	.3/ 1/ .08	.4/ 1/ .10	.4/ 1/ .10
CH4 SAMPLE PPM (1.170)	2.72	1.81	1.88	1.84
CH4 BCKGRD PPM	1.88	1.86	1.88	1.88
DILUTION FACTOR	14.07	23.53	17.16	24.16
HC CONCENTRATION PPM	9.17	.16	.21	.15
CO CONCENTRATION PPM	21.22	.01	.48	.00
CO2 CONCENTRATION PCT	.9147	.5306	.7412	.5125
NOX CONCENTRATION PPM	1.58	.20	.43	.25
CH4 CONCENTRATION PPM	.97	.03	.11	.04
NMHC CONCENTRATION PPM	8.04	.13	.08	.11
HC MASS GRAMS	.429	.013	.010	.012
CO MASS GRAMS	2.003	.001	.046	.000
CO2 MASS GRAMS	1357.54	1356.31	1104.18	1310.97
NOX MASS GRAMS	.249	.055	.068	.069
PM MASS MILLIGRAMS	5.2	3.5	.0	2.6
CH4 MASS GRAMS	.052	.003	.006	.003
NMHC MASS GRAMS (FID)	.376	.010	.004	.009
FUEL MASS KG	.429	.428	.348	.413
FUEL ECONOMY MPG (L/100KM)	23.69 (9.93)	25.57 (9.20)	29.14 (8.07)	26.39 (8.91)

4-BAG COMPOSITE RESULTS

HC	G/MI	.027	CH4	G/MI	.004
CO	G/MI	.119	NMHC	G/MI	.023
NOX	G/MI	.028			
PM	MG/MI	.7			

FUEL ECONOMY MPG (L/100KM) 26.35 (8.93)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333   TEST C-A5-P320-T2   GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY   DATE 4/22/2011 RUN   FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4   DYNO 3 BAG CART 2   H .134 C .866 O .000 X .000
TRANSMISSION A   ACTUAL ROAD LOAD 11.00 HP (8.21 KW)   FTP
ODOMETER 8266 MILES (13299 KM)   TEST WEIGHT 3625 LBS (1643 KG)

BAROMETER 28.98 IN HG (736.1 MM HG)   DRY BULB TEMPERATURE 72.2°F (22.3°C)   NOX HUMIDITY C.F. 1.017
RELATIVE HUMIDITY 64.3 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32624		32625		32622		32623	
FILTER WEIGHT GAINS (MG)	.014	.000	.008	.000	.000	.000	.006	.000
FILTER EFFICIENCY	*****		*****		.00		*****	
SAMPLE MULTIPLIER	.375		.425		.000		.425	
TOTAL WEIGHT GAIN (MG)	.014		.008		.000		.006	
PARTICULATE MASS (MG)	5.2		3.5		.0		2.6	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST C-A5-P320-T3	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/26/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8288 MILES (13335 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.71 IN HG (729.2 MM HG)   DRY BULB TEMPERATURE 71.8°F (22.1°C)   NOX HUMIDITY C.F. 1.001

RELATIVE HUMIDITY 61.8 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.1	868.1	504.7	868.0
DRY/WET CORRECTION FACTOR, SAMP/BACK	.974/.983	.978/.983	.976/.983	.978/.983
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.86 (6.21)	3.59 (5.78)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	291.6 (8.26)	291.0 (8.24)	291.1 (8.24)	289.1 (8.19)
20X20 FLOW RATE SCFM (SCMM)	45.6 (1.29)	45.7 (1.29)	46.2 (1.31)	46.3 (1.31)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.70 (.02)	.90 (.03)	.70 (.02)
TOTAL FLOW SCF (SCM)	2846. (80.6)	4881. (138.2)	2845. (80.6)	4863. (137.7)
HC SAMPLE METER/RANGE/PPM (BAG)	10.9/ 2/ 10.90	4.0/ 2/ 4.00	4.0/ 2/ 4.00	3.9/ 2/ 3.90
HC BCKGRD METER/RANGE/PPM	4.2/ 2/ 4.20	4.0/ 2/ 4.00	4.0/ 2/ 4.00	3.9/ 2/ 3.90
CO SAMPLE METER/RANGE/PPM	17.2/ 12/ 16.62	.3/ 12/ .30	.5/ 12/ .49	.3/ 12/ .30
CO BCKGRD METER/RANGE/PPM	.3/ 12/ .30	.3/ 12/ .30	.3/ 12/ .30	.2/ 12/ .20
CO2 SAMPLE METER/RANGE/PCT	51.7/ 1/ .9377	32.9/ 1/ .5748	43.5/ 1/ .7762	31.6/ 1/ .5506
CO2 BCKGRD METER/RANGE/PCT	3.1/ 1/ .0508	3.0/ 1/ .0492	3.0/ 1/ .0492	3.0/ 1/ .0492
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	3.7/ 1/ .93	1.0/ 1/ .25	2.4/ 1/ .60	1.2/ 1/ .30
NOX BCKGRD METER/RANGE/PPM	.5/ 1/ .13	.3/ 1/ .08	.3/ 1/ .08	.4/ 1/ .10
CH4 SAMPLE PPM (1.170)	2.69	1.92	2.00	1.91
CH4 BCKGRD PPM	2.00	2.02	1.94	1.96
DILUTION FACTOR	14.35	23.45	17.37	24.48
HC CONCENTRATION PPM	6.99	.17	.23	.16
CO CONCENTRATION PPM	15.72	.01	.20	.10
CO2 CONCENTRATION PCT	.8904	.5277	.7299	.5035
NOX CONCENTRATION PPM	.81	.18	.53	.20
CH4 CONCENTRATION PPM	.83	-.01	.17	.02
NMHC CONCENTRATION PPM	6.02	.17	.03	.13
HC MASS GRAMS	.325	.014	.011	.013
CO MASS GRAMS	1.475	.001	.019	.016
CO2 MASS GRAMS	1314.04	1335.64	1076.72	1269.38
NOX MASS GRAMS	.125	.047	.082	.054
PM MASS MILLIGRAMS	7.0	2.5	4.0	.8
CH4 MASS GRAMS	.045	.000	.009	.002
NMHC MASS GRAMS (FID)	.280	.014	.002	.010
FUEL MASS KG	.415	.421	.339	.400
FUEL ECONOMY MPG (L/100KM)	24.49 (9.60)	25.90 (9.08)	29.88 (7.87)	27.32 (8.61)

4-BAG COMPOSITE RESULTS

HC	G/MI	.021	CH4	G/MI	.003
CO	G/MI	.088	NMHC	G/MI	.018
NOX	G/MI	.020			
PM	MG/MI	.9			

FUEL ECONOMY MPG (L/100KM) 27.08 (8.69)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST C-A5-P320-T3	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/26/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8288 MILES (13335 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.71 IN HG (729.2 MM HG)   DRY BULB TEMPERATURE 71.8°F (22.1°C)   NOX HUMIDITY C.F. 1.001

RELATIVE HUMIDITY 61.8 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32626		32627		32628		32629	
FILTER WEIGHT GAINS (MG)	.019	.000	.005	.000	.011	.000	.002	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.373		.482		.377		.480	
TOTAL WEIGHT GAIN (MG)	.019		.005		.011		.002	
PARTICULATE MASS (MG)	7.0		2.5		4.0		.8	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST C-A5-P320-T4	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/27/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8302 MILES (13357 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 28.81 IN HG (731.8 MM HG)   DRY BULB TEMPERATURE 72.3°F (22.4°C)   NOX HUMIDITY C.F. .996

RELATIVE HUMIDITY 60.1 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.4	868.0	504.7	868.3
DRY/WET CORRECTION FACTOR, SAMP/BACK	.975/.983	.978/.983	.976/.983	.978/.983
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.86 (6.21)	3.59 (5.78)	3.85 (6.19)
BLOWER FLOW RATE SCFM (SCMM)	292.4 (8.28)	292.8 (8.29)	292.9 (8.29)	291.6 (8.26)
20X20 FLOW RATE SCFM (SCMM)	45.1 (1.28)	44.8 (1.27)	45.5 (1.29)	45.3 (1.28)
GAS METER FLOW RATE SCFM (SCMM)	.90 (.03)	.78 (.02)	.90 (.03)	.78 (.02)
TOTAL FLOW SCF (SCM)	2850. (80.7)	4895. (138.6)	2854. (80.8)	4888. (138.4)
HC SAMPLE METER/RANGE/PPM (BAG)	11.0/ 2/ 11.00	3.3/ 2/ 3.30	3.4/ 2/ 3.40	3.2/ 2/ 3.20
HC BCKGRD METER/RANGE/PPM	3.7/ 2/ 3.70	3.3/ 2/ 3.30	3.3/ 2/ 3.30	3.3/ 2/ 3.30
CO SAMPLE METER/RANGE/PPM	19.5/ 12/ 18.82	.3/ 12/ .30	.5/ 12/ .49	.2/ 12/ .20
CO BCKGRD METER/RANGE/PPM	.4/ 12/ .39	.3/ 12/ .30	.2/ 12/ .20	.2/ 12/ .20
CO2 SAMPLE METER/RANGE/PCT	51.1/ 1/ .9257	32.0/ 1/ .5580	43.0/ 1/ .7666	31.1/ 1/ .5414
CO2 BCKGRD METER/RANGE/PCT	2.8/ 1/ .0459	2.8/ 1/ .0459	2.8/ 1/ .0459	2.8/ 1/ .0459
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	6.5/ 1/ 1.63	.9/ 1/ .23	1.6/ 1/ .40	1.1/ 1/ .28
NOX BCKGRD METER/RANGE/PPM	.2/ 1/ .05	.2/ 1/ .05	.2/ 1/ .05	.2/ 1/ .05
CH4 SAMPLE PPM (1.170)	2.78	1.92	1.96	1.88
CH4 BCKGRD PPM	1.99	1.97	1.94	1.93
DILUTION FACTOR	14.53	24.16	17.59	24.91
HC CONCENTRATION PPM	7.56	.14	.29	.03
CO CONCENTRATION PPM	17.76	.01	.29	.01
CO2 CONCENTRATION PCT	.8830	.5141	.7233	.4973
NOX CONCENTRATION PPM	1.58	.18	.35	.23
CH4 CONCENTRATION PPM	.92	.04	.13	.02
NMHC CONCENTRATION PPM	6.48	.09	.14	.01
HC MASS GRAMS	.351	.011	.013	.003
CO MASS GRAMS	1.669	.001	.028	.001
CO2 MASS GRAMS	1304.72	1304.84	1070.19	1260.41
NOX MASS GRAMS	.243	.047	.054	.060
PM MASS MILLIGRAMS	5.2	6.8	2.6	.3
CH4 MASS GRAMS	.050	.003	.007	.002
NMHC MASS GRAMS (FID)	.301	.008	.007	.001
FUEL MASS KG	.412	.411	.337	.397
FUEL ECONOMY MPG (L/100KM)	24.59 (9.57)	26.51 (8.87)	30.06 (7.83)	27.38 (8.59)

4-BAG COMPOSITE RESULTS

HC	G/MI	.022	CH4	G/MI	.004
CO	G/MI	.099	NMHC	G/MI	.018
NOX	G/MI	.025			
PM	MG/MI	.9			

FUEL ECONOMY MPG (L/100KM) 27.29 (8.62)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333   TEST C-A5-P320-T4   GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY   DATE 4/27/2011 RUN   FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4   DYNO 3 BAG CART 2   H .134 C .866 O .000 X .000
TRANSMISSION A   ACTUAL ROAD LOAD 11.00 HP (8.21 KW)   FTP
ODOMETER 8302 MILES (13357 KM)   TEST WEIGHT 3625 LBS (1643 KG)

BAROMETER 28.81 IN HG (731.8 MM HG)   DRY BULB TEMPERATURE 72.3°F (22.4°C)   NOX HUMIDITY C.F. .996
RELATIVE HUMIDITY 60.1 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32637		32636		32635		32634	
FILTER WEIGHT GAINS (MG)	.014	.000	.016	.000	.007	.000	.001	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.377		.434		.376		.433	
TOTAL WEIGHT GAIN (MG)	.014		.016		.007		.001	
PARTICULATE MASS (MG)	5.2		6.8		2.6		.3	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER	KR4333	TEST N-A5-P320-T1	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL	2011 TOYOTA CAMRY	DATE 4/28/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE	2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION	A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER	8350 MILES (13435 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.32 IN HG (744.7 MM HG) DRY BULB TEMPERATURE 72.3°F (22.4°C) NOX HUMIDITY C.F. .967

RELATIVE HUMIDITY 56.0 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT	STABILIZED	HOT TRANSIENT	HOT STABILIZED
	(0-505 SEC.)	(505-1372 SEC.)	(0- 505 SEC.)	(505-1372 SEC.)
RUN TIME SECONDS	504.9	868.4	505.0	867.9
DRY/WET CORRECTION FACTOR, SAMP/BACK	.977/.985	.980/.985	.978/.985	.980/.985
MEASURED DISTANCE MILES (KM)	3.59 (5.78)	3.86 (6.21)	3.59 (5.78)	3.85 (6.19)
BLOWER FLOW RATE SCFM (SCMM)	297.4 (8.42)	297.7 (8.43)	297.7 (8.43)	298.0 (8.44)
20X20 FLOW RATE SCFM (SCMM)	47.5 (1.34)	47.1 (1.33)	47.9 (1.36)	47.4 (1.34)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.79 (.02)	.91 (.03)	.79 (.02)
TOTAL FLOW SCF (SCM)	2910. (82.4)	5002. (141.7)	2916. (82.6)	5007. (141.8)
HC SAMPLE METER/RANGE/PPM (BAG)	12.1/ 3/ 121.46	79.1/ 2/ 79.12	9.4/ 3/ 94.36	7.8/ 3/ 78.30
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	4.7/ 2/ 4.70	.6/ 3/ 6.02	.6/ 3/ 6.02
CO SAMPLE METER/RANGE/PPM	41.2/ 1/ 394.65	57.0/ 14/ 265.03	72.2/ 14/ 345.36	57.3/ 14/ 266.57
CO BCKGRD METER/RANGE/PPM	.0/ 1/ .00	.0/ 14/ .00	.1/ 14/ .42	.1/ 14/ .42
CO2 SAMPLE METER/RANGE/PCT	48.5/ 1/ .8741	30.5/ 1/ .5303	40.9/ 1/ .7261	29.4/ 1/ .5100
CO2 BCKGRD METER/RANGE/PCT	2.9/ 1/ .0475	2.9/ 1/ .0475	3.0/ 1/ .0492	2.9/ 1/ .0475
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	39.1/ 3/ 97.74	50.5/ 2/ 50.69	38.0/ 3/ 95.00	20.5/ 3/ 51.25
NOX BCKGRD METER/RANGE/PPM	.0/ 3/ .00	.1/ 2/ .10	.0/ 3/ .00	.1/ 3/ .25
CH4 SAMPLE PPM (1.170)	4.83	3.80	4.09	3.76
CH4 BCKGRD PPM	1.98	1.96	1.96	1.96
DILUTION FACTOR	14.60	23.92	17.55	24.81
HC CONCENTRATION PPM	117.72	74.61	88.68	72.52
CO CONCENTRATION PPM	380.88	257.54	333.91	258.75
CO2 CONCENTRATION PCT	.8298	.4847	.6797	.4644
NOX CONCENTRATION PPM	97.74	50.59	95.00	51.01
CH4 CONCENTRATION PPM	2.99	1.92	2.24	1.88
NMHC CONCENTRATION PPM	114.23	72.37	86.05	70.32
HC MASS GRAMS	5.591	6.092	4.221	5.926
CO MASS GRAMS	36.542	42.472	32.106	42.710
CO2 MASS GRAMS	1252.05	1257.20	1027.81	1205.54
NOX MASS GRAMS	14.898	13.254	14.511	13.376
PM MASS MILLIGRAMS	15.2	6.3	9.6	6.8
CH4 MASS GRAMS	.164	.181	.124	.177
NMHC MASS GRAMS (FID)	5.426	5.909	4.096	5.747
FUEL MASS KG	.418	.423	.344	.407
FUEL ECONOMY MPG (L/100KM)	24.24 (9.70)	25.76 (9.13)	29.47 (7.98)	26.72 (8.80)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.452	CH4	G/MI	.043
CO	G/MI	10.293	NMHC	G/MI	1.408
NOX	G/MI	3.762			
PM	MG/MI	2.5			

FUEL ECONOMY MPG (L/100KM) 26.70 (8.81)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST N-A5-P320-T1	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/28/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8350 MILES (13435 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.32 IN HG (744.7 MM HG) DRY BULB TEMPERATURE 72.3°F (22.4°C) NOX HUMIDITY C.F. .967

RELATIVE HUMIDITY 56.0 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32638		32639		32640		32641	
FILTER WEIGHT GAINS (MG)	.040	.000	.014	.000	.025	.000	.015	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.382		.438		.381		.439	
TOTAL WEIGHT GAIN (MG)	.040		.014		.025		.015	
PARTICULATE MASS (MG)	15.2		6.3		9.6		6.8	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST N-A5-P320-T2	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 4/29/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8364 MILES (13457 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.14 IN HG (740.2 MM HG)   DRY BULB TEMPERATURE 72.8°F (22.7°C)   NOX HUMIDITY C.F. 1.010

RELATIVE HUMIDITY 62.2 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	504.9	868.5	504.8	869.3
DRY/WET CORRECTION FACTOR, SAMP/BACK	.974/.982	.978/.982	.976/.982	.978/.982
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.87 (6.23)	3.60 (5.79)	3.86 (6.21)
BLOWER FLOW RATE SCFM (SCMM)	294.9 (8.35)	294.1 (8.33)	295.0 (8.36)	295.6 (8.37)
20X20 FLOW RATE SCFM (SCMM)	46.6 (1.32)	46.4 (1.31)	47.1 (1.33)	47.0 (1.33)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.78 (.02)	.91 (.03)	.78 (.02)
TOTAL FLOW SCF (SCM)	2881. (81.6)	4941. (139.9)	2886. (81.7)	4975. (140.9)
HC SAMPLE METER/RANGE/PPM (BAG)	12.5/ 3/ 125.48	79.7/ 2/ 79.72	9.5/ 3/ 95.36	77.4/ 2/ 77.42
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	4.1/ 2/ 4.10	.5/ 3/ 5.02	4.4/ 2/ 4.40
CO SAMPLE METER/RANGE/PPM	86.1/ 14/ 422.42	58.3/ 14/ 271.74	74.2/ 14/ 356.24	58.2/ 14/ 271.22
CO BCKGRD METER/RANGE/PPM	.0/ 14/ .00	.0/ 14/ .00	.1/ 14/ .42	.0/ 14/ .00
CO2 SAMPLE METER/RANGE/PCT	50.1/ 1/ .9058	30.8/ 1/ .5358	41.3/ 1/ .7338	29.8/ 1/ .5174
CO2 BCKGRD METER/RANGE/PCT	3.1/ 1/ .0508	3.1/ 1/ .0508	3.1/ 1/ .0508	3.2/ 1/ .0525
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	40.2/ 3/ 100.49	51.0/ 2/ 51.18	37.8/ 3/ 94.50	50.7/ 2/ 50.88
NOX BCKGRD METER/RANGE/PPM	.0/ 3/ .00	.1/ 2/ .10	.0/ 3/ .00	.0/ 2/ .00
CH4 SAMPLE PPM (1.170)	5.18	3.97	4.31	3.96
CH4 BCKGRD PPM	2.16	2.17	2.16	2.16
DILUTION FACTOR	14.07	23.66	17.35	24.47
HC CONCENTRATION PPM	121.75	75.79	90.63	73.20
CO CONCENTRATION PPM	406.59	263.49	343.68	263.08
CO2 CONCENTRATION PCT	.8586	.4871	.6859	.4670
NOX CONCENTRATION PPM	100.49	51.08	94.50	50.88
CH4 CONCENTRATION PPM	3.17	1.89	2.27	1.89
NMHC CONCENTRATION PPM	118.04	73.58	87.98	70.99
HC MASS GRAMS	5.725	6.112	4.269	5.944
CO MASS GRAMS	38.623	42.920	32.703	43.152
CO2 MASS GRAMS	1282.63	1247.93	1026.38	1204.75
NOX MASS GRAMS	15.840	13.807	14.920	13.849
PM MASS MILLIGRAMS	11.2	7.1	7.7	6.3
CH4 MASS GRAMS	.172	.177	.124	.177
NMHC MASS GRAMS (FID)	5.551	5.934	4.144	5.765
FUEL MASS KG	.429	.421	.344	.407
FUEL ECONOMY MPG (L/100KM)	23.70 (9.93)	25.99 (9.05)	29.57 (7.96)	26.79 (8.78)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.462	CH4	G/MI	.043
CO	G/MI	10.490	NMHC	G/MI	1.418
NOX	G/MI	3.905			
PM	MG/MI	2.1			

FUEL ECONOMY MPG (L/100KM) 26.67 (8.82)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333   TEST N-A5-P320-T2   GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY   DATE 4/29/2011 RUN   FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4   DYNO 3 BAG CART 2   H .134 C .866 O .000 X .000
TRANSMISSION A   ACTUAL ROAD LOAD 11.00 HP (8.21 KW)   FTP
ODOMETER 8364 MILES (13457 KM)   TEST WEIGHT 3625 LBS (1643 KG)

BAROMETER 29.14 IN HG (740.2 MM HG)   DRY BULB TEMPERATURE 72.8°F (22.7°C)   NOX HUMIDITY C.F. 1.010
RELATIVE HUMIDITY 62.2 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32642		32643		32644		32645	
FILTER WEIGHT GAINS (MG)	.030	.000	.016	.000	.020	.000	.014	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.377		.440		.378		.439	
TOTAL WEIGHT GAIN (MG)	.030		.016		.020		.014	
PARTICULATE MASS (MG)	11.2		7.1		7.7		6.3	

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R   4-BAG EPA FTP VEHICLE EMISSION RESULTS   PROJECT NO. 03-16085-00

VEHICLE NUMBER KR4333	TEST N-A5-P320-T3	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL 2011 TOYOTA CAMRY	DATE 5/ 2/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE 2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER 8386 MILES (13493 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.22 IN HG (742.2 MM HG)   DRY BULB TEMPERATURE 73.2°F (22.9°C)   NOX HUMIDITY C.F. .962

RELATIVE HUMIDITY 53.2 PCT.

BAG NUMBER	1	2	3	4
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)	STABILIZED (505-1372 SEC.)	HOT TRANSIENT (0- 505 SEC.)	HOT STABILIZED (505-1372 SEC.)
RUN TIME SECONDS	505.0	868.1	505.0	868.0
DRY/WET CORRECTION FACTOR, SAMP/BACK	.977/.985	.980/.985	.978/.985	.980/.985
MEASURED DISTANCE MILES (KM)	3.60 (5.79)	3.87 (6.23)	3.59 (5.78)	3.87 (6.23)
BLOWER FLOW RATE SCFM (SCMM)	295.1 (8.36)	295.2 (8.36)	295.8 (8.38)	296.1 (8.39)
20X20 FLOW RATE SCFM (SCMM)	47.1 (1.33)	46.6 (1.32)	47.4 (1.34)	47.2 (1.34)
GAS METER FLOW RATE SCFM (SCMM)	.91 (.03)	.78 (.02)	.91 (.03)	.78 (.02)
TOTAL FLOW SCF (SCM)	2888. (81.8)	4956. (140.3)	2896. (82.0)	4977. (140.9)
HC SAMPLE METER/RANGE/PPM (BAG)	12.0/ 3/ 120.46	81.3/ 2/ 81.32	9.6/ 3/ 96.37	81.8/ 2/ 81.82
HC BCKGRD METER/RANGE/PPM	.4/ 3/ 4.02	4.3/ 2/ 4.30	.4/ 3/ 4.02	3.7/ 2/ 3.70
CO SAMPLE METER/RANGE/PPM	52.5/ 1/ 508.65	68.9/ 14/ 327.57	86.6/ 14/ 425.26	68.6/ 14/ 325.96
CO BCKGRD METER/RANGE/PPM	.0/ 1/ .00	.2/ 14/ .83	.1/ 14/ .42	.1/ 14/ .42
CO2 SAMPLE METER/RANGE/PCT	48.7/ 1/ .8780	29.8/ 1/ .5174	40.5/ 1/ .7184	29.1/ 1/ .5045
CO2 BCKGRD METER/RANGE/PCT	2.8/ 1/ .0459	2.8/ 1/ .0459	2.8/ 1/ .0459	2.8/ 1/ .0459
NOX SAMPLE METER/RANGE/PPM (BAG) (D)	97.8/ 2/ 97.97	48.8/ 2/ 49.00	90.2/ 2/ 90.29	49.8/ 2/ 49.99
NOX BCKGRD METER/RANGE/PPM	.1/ 2/ .10	.1/ 2/ .10	.1/ 2/ .10	.1/ 2/ .10
CH4 SAMPLE PPM (1.170)	5.15	4.00	4.31	4.02
CH4 BCKGRD PPM	1.91	1.96	1.97	1.96
DILUTION FACTOR	14.36	24.21	17.54	24.78
HC CONCENTRATION PPM	116.72	77.20	92.58	78.27
CO CONCENTRATION PPM	491.34	317.90	411.70	316.81
CO2 CONCENTRATION PCT	.8354	.4734	.6752	.4605
NOX CONCENTRATION PPM	97.87	48.90	90.20	49.89
CH4 CONCENTRATION PPM	3.37	2.12	2.45	2.14
NMHC CONCENTRATION PPM	112.78	74.71	89.71	75.76
HC MASS GRAMS	5.502	6.244	4.376	6.358
CO MASS GRAMS	46.779	51.942	39.309	51.982
CO2 MASS GRAMS	1250.77	1216.40	1013.80	1188.19
NOX MASS GRAMS	14.722	12.624	13.607	12.934
PM MASS MILLIGRAMS	12.0	8.2	7.8	9.6
CH4 MASS GRAMS	.184	.198	.134	.201
NMHC MASS GRAMS (FID)	5.316	6.044	4.240	6.154
FUEL MASS KG	.423	.415	.343	.407
FUEL ECONOMY MPG (L/100KM)	24.05 (9.78)	26.32 (8.94)	29.53 (7.97)	26.89 (8.75)

4-BAG COMPOSITE RESULTS

HC	G/MI	1.496	CH4	G/MI	.048
CO	G/MI	12.659	NMHC	G/MI	1.448
NOX	G/MI	3.602			
PM	MG/MI	2.5			

FUEL ECONOMY MPG (L/100KM) 26.84 (8.76)

SOUTHWEST RESEARCH INSTITUTE - DEPARTMENT OF EMISSIONS RESEARCH

COMPUTER PROGRAM LDT 3.2-R 4-BAG EPA FTP VEHICLE EMISSION RESULTS PROJECT NO. 03-16085-00

VEHICLE NUMBER	KR4333	TEST N-A5-P320-T3	GASOLINE A5 IBP 3 EM-7908-F
VEHICLE MODEL	2011 TOYOTA CAMRY	DATE 5/ 2/2011 RUN	FUEL DENSITY 6.228 LB/GAL
ENGINE	2.5 L (153 CID)-4	DYNO 3 BAG CART 2	H .134 C .866 O .000 X .000
TRANSMISSION	A	ACTUAL ROAD LOAD 11.00 HP (8.21 KW)	FTP
ODOMETER	8386 MILES (13493 KM)	TEST WEIGHT 3625 LBS (1643 KG)	

BAROMETER 29.22 IN HG (742.2 MM HG) DRY BULB TEMPERATURE 73.2°F (22.9°C) NOX HUMIDITY C.F. .962

RELATIVE HUMIDITY 53.2 PCT.

BAG NUMBER	1		2		3		4	
BAG DESCRIPTION	COLD TRANSIENT (0-505 SEC.)		STABILIZED (505-1372 SEC.)		HOT TRANSIENT (0- 505 SEC.)		HOT STABILIZED (505-1372 SEC.)	
FILTER NUMBERS	32649		32648		32647		32646	
FILTER WEIGHT GAINS (MG)	.032	.000	.019	.000	.021	.000	.022	.000
FILTER EFFICIENCY	*****		*****		*****		*****	
SAMPLE MULTIPLIER	.377		.439		.379		.444	
TOTAL WEIGHT GAIN (MG)	.032		.019		.021		.022	
PARTICULATE MASS (MG)	12.0		8.2		7.8		9.6	

APPENDIX B

HYDROCARBON SPECIATION DATA

TABLE	PAGES	TITLE
B-1	B-1 to B-6	Cold- and Hot-Start Hydrocarbon Speciation Data for 211b Baseline Fuel With Aftertreatment (Background Corrected)
B-2	B-7 to B-12	Cold- and Hot-Start Hydrocarbon Speciation Data for 211b Baseline Fuel Without Aftertreatment (Background Corrected)
B-3	B-13 to B-18	Cold- and Hot-Start Hydrocarbon Speciation Data for KiOR Renewable Diesel Blendstock 5 With Aftertreatment (Background Corrected)
B-4	B-19 to B-24	Cold- and Hot-Start Hydrocarbon Speciation Data for KiOR Renewable Diesel Blendstock 5 Without Aftertreatment (Background Corrected)
B-5	B-25 to B-30	Comparison of Composite Hydrocarbon Speciation Data With Aftertreatment (Background Corrected)
B-6	B-31 to B-36	Comparison of Composite Hydrocarbon Speciation Data Without Aftertreatment (Background Corrected)

TABLE B-1. COLD- AND HOT-START HYDROCARBON SPECIATION DATA
FOR 211b BASELINE FUEL WITH AFTERTREATMENT
(BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-BA-C1**	**C-BA-C2**	**C-BA-C3**	**Average**	**C-BA-H1**	**C-BA-H2**	**C-BA-H3**	**Average**
METHANE	12.5	7.9	13.0	11.1	13.1	14.5	19.1	15.5
ETHANE	0.9	1.1	1.1	1.0	0.6	0.6	0.7	0.6
ETHYLENE	14.1	12.6	10.4	12.3	0.9	0.8	0.9	0.9
PROPANE	0.1	0.2	0.1	0.1	Trace	Trace	Trace	Trace
PROPYLENE	5.0	4.2	3.3	4.2	ND	ND	ND	ND
ACETYLENE	0.4	ND	ND	0.1	ND	ND	ND	ND
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	0.3	0.3	0.2	0.3	ND	ND	ND	ND
1-BUTENE	0.5	0.3	0.3	0.4	ND	ND	ND	ND
2-METHYLPROPENE (ISOBUTYLENE)	0.6	0.6	0.4	0.5	ND	ND	ND	ND
2,2-DIMETHYLPROPANE (NEOPENTANE)	ND	Trace	0.1	Trace	0.1	ND	Trace	Trace
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	0.2	ND	ND	0.1	ND	ND	ND	ND
2-METHYLPROPANE (ISOBUTANE)	Trace	ND	Trace	Trace	ND	ND	ND	ND
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	Trace	ND	ND	Trace	0.2	0.2	Trace	0.2
UNIDENTIFIED C5 OLEFINS	Trace	ND	ND	Trace	ND	ND	ND	ND
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	0.3	0.6	ND	0.4	ND	0.4	ND	0.1
2-METHYL-2-BUTENE	0.3	0.3	ND	0.3	ND	ND	ND	ND
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTENE	0.2	ND	ND	Trace	ND	ND	ND	ND
4-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLBUTANE	0.3	0.4	0.3	0.3	ND	ND	ND	ND

TABLE B-1 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA
FOR 211b BASELINE FUEL WITH AFTERTREATMENT
(BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	C-BA-C1	C-BA-C2	C-BA-C3	Average	C-BA-H1	C-BA-H2	C-BA-H3	Average
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	Trace	0.1	Trace	Trace	ND	ND	ND	ND
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	0.2	ND	ND	Trace	ND	ND	ND	ND
1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXANE	0.1	ND	ND	Trace	ND	ND	Trace	Trace
UNIDENTIFIED C6	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	1.6	1.1	1.1	1.3	ND	ND	ND	ND
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	0.3	0.3	0.4	0.3	ND	ND	ND	ND
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-1 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-BA-C1**	**C-BA-C2**	**C-BA-C3**	**Average**	**C-BA-H1**	**C-BA-H2**	**C-BA-H3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	0.1	Trace	0.1	0.1	ND	0.2	Trace	0.1
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	ND	ND	0.2	Trace	ND	ND	ND	ND
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	0.3	Trace	0.2	0.3	ND	ND	ND	ND
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,3-TRIMETHYLPENTANE	0.2	0.2	0.3	0.2	ND	ND	ND	ND
TOLUENE	0.7	0.3	0.5	0.5	0.1	ND	Trace	Trace
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-1 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA
FOR 211b BASELINE FUEL WITH AFTERTREATMENT
(BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-BA-C1**	**C-BA-C2**	**C-BA-C3**	**Average**	**C-BA-H1**	**C-BA-H2**	**C-BA-H3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	0.2	0.2	0.2	0.2	ND	ND	ND	ND
UNIDENTIFIED C8	ND	0.3	ND	0.1	ND	ND	ND	ND
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	0.3	0.3	0.2	0.2	ND	ND	ND	ND
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-1 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA
FOR 211b BASELINE FUEL WITH AFTERTREATMENT
(BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-BA-C1**	**C-BA-C2**	**C-BA-C3**	**Average**	**C-BA-H1**	**C-BA-H2**	**C-BA-H3**	**Average**
o-XYLENE	ND	0.2	ND	0.1	ND	ND	ND	ND
1-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	0.3	0.2	ND	0.2	ND	ND	ND	ND
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	0.3	0.2	0.1	0.2	0.5	0.2	ND	0.2
ISOBUTYLBENZENE, NOTE F	0.3	0.2	0.1	0.2	0.5	0.2	ND	0.2
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	0.2	0.2	ND	0.1	ND	ND	ND	ND
1,2,3-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ISOPROPYLBENZENE	ND	0.2	ND	0.1	ND	0.4	ND	0.1
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	ND	0.2	ND	0.1	ND	ND	ND	ND
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNDECANE	0.5	0.4	ND	0.3	ND	ND	ND	ND
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-1 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-BA-C1**	**C-BA-C2**	**C-BA-C3**	**Average**	**C-BA-H1**	**C-BA-H2**	**C-BA-H3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-2-METHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
N-PENT-BENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	ND	0.7	ND	0.2	0.5	0.5	ND	0.3
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	0.4	ND	ND	0.1	ND	ND	ND	ND
FORMALDEHYDE	13.9	12.1	8.6	11.5	0.5	1.5	1.1	1.1
ACETALDEHYDE	4.0	2.4	1.8	2.7	0.2	0.1	0.1	0.1
ACROLEIN	0.3	0.2	0.1	0.2	ND	ND	ND	ND
ACETONE	1.3	0.6	ND	0.6	ND	ND	ND	ND
PROPIONALDEHYDE	ND	Trace	ND	Trace	ND	0.1	ND	Trace
CROTONALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
n-BUTYRALDEHYDE, NOTE H	ND	0.2	Trace	0.1	Trace	ND	0.1	Trace
METHYL ETHYL KETONE, NOTE H	0.1	0.1	ND	0.1	Trace	0.1	ND	Trace
BENZALDEHYDE	Trace	Trace	ND	Trace	ND	ND	ND	ND
ISOVALERALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
VALERALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
O-TOLUALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
M/P-TOLUALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
HEXANALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYLBENZALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
SUMMED SPECIATED VALUES	**61.6**	**49.9**	**43.4**	**51.6**	**17.2**	**20.0**	**22.2**	**19.8**

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
METHANE	10.6	10.6	10.9	10.7	9.1	9.1	12.0	10.0
ETHANE	0.8	0.8	0.7	0.8	0.4	0.2	0.4	0.3
ETHYLENE	36.5	35.9	34.9	35.8	25.3	24.7	26.2	25.4
PROPANE	1.6	0.4	0.1	0.7	ND	0.1	Trace	Trace
PROPYLENE	11.5	11.3	10.7	11.2	6.8	6.4	6.8	6.7
ACETYLENE	10.9	10.4	10.4	10.6	8.6	8.3	8.7	8.5
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2
1-BUTENE	2.8	2.8	2.6	2.7	1.4	1.4	1.5	1.4
2-METHYLPROPENE (ISOBUTYLENE)	1.4	1.4	1.3	1.3	0.8	0.7	0.8	0.7
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.8	0.8	ND	0.5	0.5	0.5	ND	0.3
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	3.1	3.2	2.9	3.1	1.9	1.9	2.0	1.9
2-METHYLPROPANE (ISOBUTANE)	Trace	0.1	ND	Trace	ND	0.2	ND	0.1
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	0.5	0.6	0.5	0.6	0.3	0.3	0.3	0.3
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.5	0.7	0.1	0.4	0.4	0.3	0.8	0.5
UNIDENTIFIED C5 OLEFINS	ND	ND	0.3	0.1	ND	ND	0.3	0.1
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	ND	0.2	0.8	0.3	0.5	0.5	0.5	0.5
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	ND	ND	0.2	0.1	ND	ND	0.4	0.1
2-METHYL-2-BUTENE	ND	0.4	ND	0.1	ND	ND	ND	ND
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	0.8	1.0	ND	0.6	0.3	ND	0.3	0.2
2,2-DIMETHYLBUTANE	0.4	0.7	0.5	0.5	0.6	0.6	0.6	0.6
CYCLOPENTENE	0.2	0.4	0.3	0.3	0.4	0.4	0.5	0.4
4-METHYL-1-PENTENE	1.0	1.5	1.5	1.3	0.2	0.3	0.3	0.3
3-METHYL-1-PENTENE	ND	ND	ND	ND	0.3	0.2	0.2	0.3
CYCLOPENTANE	ND	ND	ND	ND	0.3	0.3	0.2	0.2
2,3-DIMETHYLBUTANE	ND	ND	0.4	0.1	ND	ND	ND	ND

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	2.3	2.5	1.5	2.1	0.4	0.2	ND	0.2
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	ND	ND	ND	ND	0.3	0.2	0.4	0.3
1-HEXENE	ND	ND	ND	ND	0.3	0.2	0.4	0.3
HEXANE	0.5	0.8	1.2	0.8	0.2	0.1	ND	0.1
UNIDENTIFIED C6	ND	0.2	0.4	0.2	ND	ND	0.4	0.1
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	3.4	3.8	3.7	3.6	2.8	2.8	2.9	2.8
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA
FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT
(BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	0.5	0.6	0.5	0.6	0.3	0.2	0.3	0.3
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	ND	0.2	0.1	0.1	ND	ND	Trace	Trace
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	0.2	ND	0.2	0.1	ND	ND	ND	ND
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	0.3	ND	0.3	0.2	ND	ND	0.3	0.1
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	0.2	ND	0.2	0.1
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	0.2	ND	0.2	0.1	ND	ND	0.1	Trace
2,3,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	1.0	ND	ND	0.3	0.5	0.6	ND	0.4
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.5	0.5	0.5	0.5	ND	ND	ND	ND
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	ND	ND	ND	ND	0.3	0.3	0.3	0.3
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	0.2	ND	0.2	0.1	ND	ND	ND	ND
UNIDENTIFIED C8	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	0.2	0.2	0.3	0.2	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	0.3	0.2	0.3	0.3	ND	ND	0.2	0.1
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	0.5	0.4	0.5	0.5	0.5	0.3	0.3	0.4
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	1.1	ND	ND	0.4	0.9	ND	ND	0.3
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	0.2	ND	0.2	0.1	ND	ND	ND	ND
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	0.6	0.6	0.6	0.6	0.2	0.4	0.3	0.3

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
o-XYLENE	0.4	0.5	0.6	0.5	0.3	0.4	0.4	0.4
1-NONENE	0.3	0.3	0.4	0.4	ND	ND	ND	ND
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	1.0	0.6	0.6	0.7	0.3	0.3	0.2	0.3
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	0.3	0.2	0.3	0.3	ND	ND	ND	ND
1-METHYL-3-ETHYLBENZENE	0.3	0.6	0.4	0.4	ND	ND	ND	ND
1-METHYL-4-ETHYLBENZENE	ND	0.2	Trace	0.1	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	1.7	2.4	1.7	1.9	0.2	ND	0.4	0.2
1-METHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	0.4	0.1
1,2,4-TRIMETHYLBENZENE	0.8	0.7	0.7	0.8	0.6	0.5	0.6	0.6
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	0.4	0.4	0.5	0.4	0.1	0.1	0.4	0.2
ISOBUTYLBENZENE, NOTE F	0.3	0.4	0.4	0.4	0.1	0.1	0.3	0.2
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	0.4	0.3	0.4	0.4	ND	ND	ND	ND
1,2,3-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ISOPROPYLBENZENE	0.2	ND	0.2	0.2	0.3	0.3	0.4	0.3
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	0.2	0.2	0.2	0.2	ND	0.3	0.3	0.2
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.5	0.5	0.6	0.5	0.3	0.3	0.4	0.3
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	0.3	ND	ND	0.1	ND	ND	0.3	0.1
1,4-DIMETHYL-2-ETHYLBENZENE	ND	0.6	0.2	0.3	ND	0.6	ND	0.2
1,3-DIMETHYL-4-ETHYLBENZENE	0.8	0.6	0.7	0.7	0.3	0.3	0.4	0.4
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	0.3	0.2	ND	0.2	0.2	ND	ND	0.1
UNDECANE	0.8	0.7	1.0	0.8	0.5	0.6	0.7	0.6
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	0.2	0.3	0.3	0.2	ND	ND	0.2	0.1
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.5	0.5	0.6	0.5	ND	ND	ND	ND

TABLE B-2 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 211b BASELINE FUEL WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-BA-C1**	**N-BA-C2**	**N-BA-C3**	**Average**	**N-BA-H1**	**N-BA-H2**	**N-BA-H3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	0.3	0.3	0.4	0.3
TERT-1-BUT-2-METHYLBENZENE	0.3	0.7	0.7	0.5	0.3	0.4	ND	0.2
1,2,3,4-TETRAMETHYLBENZENE	0.2	0.4	0.5	0.4	0.2	0.4	0.4	0.3
N-PENT-BENZENE	0.5	0.4	0.4	0.4	0.3	0.3	0.2	0.3
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	0.3	0.2	0.2	ND	0.3	0.6	0.3
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	0.7	0.8	1.0	0.8	0.3	0.6	1.3	0.7
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	ND	ND	0.4	0.1	ND	ND	ND	ND
FORMALDEHYDE	42.6	44.0	45.8	44.1	25.4	25.5	26.7	25.8
ACETALDEHYDE	14.6	15.3	15.1	15.0	7.5	7.8	8.0	7.8
ACROLEIN	7.4	8.4	8.1	8.0	4.2	4.8	4.9	4.6
ACETONE	5.6	6.1	6.3	6.0	3.1	3.3	3.0	3.1
PROPIONALDEHYDE	2.7	2.7	2.7	2.7	0.9	ND	1.0	0.6
CROTONALDEHYDE	1.5	1.6	1.5	1.5	0.8	0.8	0.4	0.7
n-BUTYRALDEHYDE, NOTE H	1.8	1.7	2.0	1.8	0.7	0.7	0.2	0.6
METHYL ETHYL KETONE, NOTE H	1.1	1.2	1.1	1.2	0.5	0.5	ND	0.3
BENZALDEHYDE	4.7	4.8	5.6	5.0	3.0	3.2	3.8	3.4
ISOVALERALDEHYDE	0.3	0.3	0.6	0.4	0.1	ND	0.3	0.1
VALERALDEHYDE	1.2	1.3	1.4	1.3	0.6	0.4	0.6	0.5
O-TOLUALDEHYDE	3.5	3.4	4.7	3.9	2.1	2.1	2.6	2.3
M/P-TOLUALDEHYDE	1.5	1.3	1.9	1.6	0.8	0.8	1.0	0.9
HEXANALDEHYDE	0.3	0.5	0.7	0.5	ND	0.1	ND	Trace
DIMETHYLBENZALDEHYDE	0.5	0.8	1.2	0.8	0.2	0.4	0.8	0.5
SUMMED SPECIATED VALUES	**197.0**	**200.6**	**206.3**	**201.3**	**120.1**	**118.5**	**131.5**	**123.4**

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	C-A5-C1	C-A5-C2	C-A5-C3	Average	C-A5-H1	C-A5-H2	C-A5-H3	Average
METHANE	12.8	11.6	10.0	11.5	11.1	10.4	10.0	10.5
ETHANE	1.0	1.0	0.9	0.9	0.6	0.6	0.5	0.6
ETHYLENE	12.3	11.9	11.2	11.8	0.8	0.8	0.6	0.7
PROPANE	1.6	0.2	0.1	0.6	Trace	Trace	Trace	Trace
PROPYLENE	3.8	3.6	3.7	3.7	ND	ND	ND	ND
ACETYLENE	0.3	0.2	0.3	0.3	ND	ND	ND	ND
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	0.2	0.2	0.2	0.2	ND	ND	ND	ND
1-BUTENE	0.3	ND	0.3	0.2	ND	ND	ND	ND
2-METHYLPROPENE (ISOBUTYLENE)	0.5	0.5	0.5	0.5	ND	ND	ND	ND
2,2-DIMETHYLPROPANE (NEOPENTANE)	ND	ND	ND	ND	0.1	ND	ND	Trace
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPROPANE (ISOBUTANE)	Trace	0.1	Trace	Trace	Trace	Trace	ND	Trace
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.1	0.3	0.1	0.2	ND	ND	ND	ND
UNIDENTIFIED C5 OLEFINS	0.3	0.1	0.2	0.2	Trace	0.1	ND	Trace
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	0.3	ND	ND	0.1	0.2	ND	ND	0.1
2-METHYL-2-BUTENE	0.3	0.3	0.3	0.3	ND	ND	ND	ND
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	C-A5-C1	C-A5-C2	C-A5-C3	Average	C-A5-H1	C-A5-H2	C-A5-H3	Average
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	0.1	0.3	0.1	0.2	0.1	ND	ND	Trace
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	ND	0.1	ND	Trace	ND	Trace	ND	Trace
1-HEXENE	ND	0.1	ND	Trace	ND	Trace	ND	Trace
HEXANE	ND	ND	Trace	Trace	0.1	0.1	0.1	0.1
UNIDENTIFIED C6	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	1.4	1.4	1.1	1.3	ND	0.2	0.2	0.1
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	ND	Trace	ND	Trace	0.1	0.3	0.4	0.2
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-A5-C1**	**C-A5-C2**	**C-A5-C3**	**Average**	**C-A5-H1**	**C-A5-H2**	**C-A5-H3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	0.2	ND	0.1	0.1	0.2	ND	Trace	0.1
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	0.2	0.2	0.2	0.2	ND	Trace	0.3	0.1
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	ND	ND	0.3	ND	ND	0.1
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	0.2	0.2	0.2	0.2	ND	0.2	0.2	0.1
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.8	ND	ND	0.3	ND	ND	ND	ND
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,3-TRIMETHYLPENTANE	0.3	ND	ND	0.1	ND	ND	ND	ND
TOLUENE	1.3	0.5	0.6	0.8	ND	0.1	ND	Trace
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-A5-C1**	**C-A5-C2**	**C-A5-C3**	**Average**	**C-A5-H1**	**C-A5-H2**	**C-A5-H3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	0.3	0.3	0.2	0.3	ND	ND	0.3	0.1
UNIDENTIFIED C8	ND	ND	ND	ND	ND	ND	0.2	Trace
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	0.2	Trace
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	C-A5-C1	C-A5-C2	C-A5-C3	Average	C-A5-H1	C-A5-H2	C-A5-H3	Average
o-XYLENE	0.3	ND	0.3	0.2	ND	ND	ND	ND
1-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	0.5	ND	ND	ND	0.2	0.3	ND	0.1
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	Trace	0.1	ND	Trace	Trace	Trace	ND	Trace
ISOBUTYLBENZENE, NOTE F	Trace	0.1	ND	Trace	Trace	Trace	ND	Trace
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	0.2	0.3	0.2	0.2	0.4	ND	ND	0.1
1,2,3-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ISOPROPYLBENZENE	0.2	0.3	0.2	0.3	ND	0.2	ND	Trace
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.2	0.3	ND	0.2	ND	ND	ND	ND
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIMETHYL-2-ETHYLBENZENE	0.4	0.2	ND	0.2	ND	ND	ND	ND
1,3-DIMETHYL-4-ETHYLBENZENE	ND	0.2	ND	0.1	ND	0.2	ND	Trace
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNDECANE	0.5	0.5	ND	0.3	ND	0.3	ND	0.1
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	0.2	ND	Trace
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-3 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**C-A5-C1**	**C-A5-C2**	**C-A5-C3**	**Average**	**C-A5-H1**	**C-A5-H2**	**C-A5-H3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-2-METHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
N-PENT-BENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	1.1	0.4	0.5	0.7	0.6	0.5	0.3	0.4
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	ND	ND	ND	ND	ND	ND	ND	ND
FORMALDEHYDE	11.3	10.3	11.0	10.9	0.8	1.2	1.0	1.0
ACETALDEHYDE	2.4	2.2	2.2	2.2	0.1	0.1	0.1	0.1
ACROLEIN	0.2	0.2	0.2	0.2	ND	ND	ND	ND
ACETONE	1.9	1.4	1.1	1.5	0.2	0.3	0.1	0.2
PROPIONALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
CROTONALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
n-BUTYRALDEHYDE, NOTE H	ND	0.1	ND	Trace	ND	0.1	0.1	0.1
METHYL ETHYL KETONE, NOTE H	0.1	ND	ND	Trace	Trace	ND	ND	Trace
BENZALDEHYDE	Trace	Trace	Trace	Trace	ND	ND	ND	ND
ISOVALERALDEHYDE	ND	0.2	0.2	0.1	ND	ND	Trace	Trace
VALERALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
O-TOLUALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
M/P-TOLUALDEHYDE	0.1	0.1	Trace	0.1	ND	ND	ND	ND
HEXANALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYLBENZALDEHYDE	Trace	ND	ND	Trace	ND	ND	ND	ND
SUMMED SPECIATED VALUES	59.7	50.4	46.7	52.3	16.4	16.2	14.6	15.7

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
METHANE	9.7	11.7	10.2	10.6	8.4	8.4	3.6	6.8
ETHANE	0.7	0.7	0.8	0.8	0.3	0.4	0.4	0.4
ETHYLENE	33.7	36.5	35.9	35.4	24.7	26.1	25.7	25.5
PROPANE	0.1	0.1	0.1	0.1	Trace	Trace	ND	Trace
PROPYLENE	10.4	11.5	11.2	11.0	6.5	6.9	6.8	6.7
ACETYLENE	10.4	11.2	11.0	10.9	8.4	9.1	9.0	8.9
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	0.4	0.4	0.5	0.4	0.2	0.2	0.2	0.2
1-BUTENE	2.5	2.8	2.8	2.7	1.4	1.5	1.5	1.4
2-METHYLPROPENE (ISOBUTYLENE)	1.2	1.4	1.4	1.4	0.8	0.7	0.8	0.7
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.7	0.8	0.7	0.7	0.5	0.5	0.5	0.5
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	2.8	3.1	2.7	2.9	1.9	2.0	1.7	1.8
2-METHYLPROPANE (ISOBUTANE)	ND	0.1	0.3	0.1	ND	ND	0.3	0.1
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	0.5	0.6	ND	0.4	0.3	0.3	0.3	0.3
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.1	0.7	ND	0.3	0.2	0.5	0.1	0.3
UNIDENTIFIED C5 OLEFINS	ND	ND	0.1	Trace	ND	ND	ND	ND
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	0.3	0.3	0.3	0.3	0.2	ND	ND	0.1
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	ND	ND	0.3	0.1	ND	ND	0.2	0.1
2-METHYL-2-BUTENE	0.1	0.4	0.4	0.3	0.2	0.6	ND	0.3
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	0.8	0.8	0.9	0.8	0.6	0.2	0.5	0.4
2,2-DIMETHYLBUTANE	0.5	0.6	0.7	0.6	0.4	0.5	0.4	0.4
CYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-1-PENTENE	1.1	ND	0.8	0.6	0.2	0.2	0.2	0.2
3-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLBUTANE	0.3	0.1	ND	0.1	0.1	ND	0.1	0.1

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	1.7	1.9	1.4	1.6	0.2	ND	0.3	0.2
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-HEXENE	ND	0.2	1.3	0.5	ND	0.3	0.2	0.2
HEXANE	1.3	1.4	1.1	1.2	0.7	0.5	0.5	0.6
UNIDENTIFIED C6	ND	ND	0.4	0.1	ND	ND	ND	ND
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	0.2	0.1	0.3	0.2	0.9	0.2	ND	0.4
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	3.6	3.7	3.9	3.7	2.8	3.0	3.1	2.9
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	ND	0.2	ND	Trace	ND	ND	ND	ND
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	0.6	0.6	0.7	0.6	0.3	0.3	0.3	0.3
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	ND	ND	0.3	0.1	ND	ND	0.1	Trace
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	0.4	0.1	ND	ND	ND	ND
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	0.2	ND	ND	0.1	0.3	0.3	ND	0.2
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	0.3	0.3	0.3	0.3	ND	ND	0.2	0.1
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	0.5	0.3	0.5	0.5	0.3	0.3	0.4	0.3
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	0.1	0.3	0.1	0.2	0.1	0.2	Trace	0.1
2,3,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	1.1	1.2	1.2	1.2	0.6	0.7	0.8	0.7
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.4	0.5	0.5	0.4	0.3	0.3	0.3	0.3
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	0.2	0.2	0.2	0.2	ND	0.2	0.2	0.1
UNIDENTIFIED C8	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	0.3	0.4	0.2	0.3	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	ND	0.2	ND	Trace	ND	ND	0.4	0.1
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	1.3	1.3	1.1	1.2	0.8	0.9	0.5	0.7
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	0.2	0.2	0.2	0.2	0.4	0.4	0.2	0.3
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	0.7	0.7	ND	0.5	ND	ND	ND	ND

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR 5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
o-XYLENE	0.5	0.5	0.5	0.5	0.2	0.4	0.2	0.2
1-NONENE	0.4	0.3	0.7	0.5	ND	ND	0.3	0.1
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	0.6	0.5	0.6	0.6	0.2	0.7	0.3	0.4
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	0.4	0.4	0.3	0.4	ND	ND	0.2	0.1
1-METHYL-3-ETHYLBENZENE	0.4	0.4	0.4	0.4	0.2	ND	0.3	0.1
1-METHYL-4-ETHYLBENZENE	ND	ND	0.2	0.1	ND	ND	0.3	0.1
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ETHYLBENZENE	0.2	ND	ND	0.1	0.3	ND	ND	0.1
1,2,4-TRIMETHYLBENZENE	0.5	0.6	1.3	0.8	0.6	0.7	0.8	0.7
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	0.3	0.3	0.2	0.3	0.1	0.1	ND	0.1
ISOBUTYLBENZENE, NOTE F	0.3	0.3	0.2	0.2	0.1	0.1	ND	0.1
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	0.3	0.4	0.3	0.3	0.2	0.4	0.2	0.3
1,2,3-TRIMETHYLBENZENE	ND	ND	0.3	0.1	ND	ND	0.2	0.1
1-METHYL-4-ISOPROPYLBENZENE	0.2	0.2	0.2	0.2	0.2	0.2	ND	0.1
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	ND	ND	0.3	0.1	ND	ND	0.2	0.1
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	ND	0.5	0.5	0.4	0.3	0.4	0.3	0.3
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-4-ETHYLBENZENE	0.7	0.7	0.7	0.7	0.4	0.4	0.4	0.4
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2
UNDECANE	0.8	0.9	0.8	0.8	0.7	0.7	0.8	0.7
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	0.2	0.3	0.3	0.3	ND	ND	ND	ND
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.5	0.6	0.6	0.5	0.3	0.3	0.4	0.3

TABLE B-4 (CONT'D). COLD- AND HOT-START HYDROCARBON SPECIATION DATA FOR
5 % RENEWABLE DIESEL BLEND WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Cold Transient, mg/bhp-hr				Hot Transient, mg/bhp-hr			
COMPOUND	**N-A5-C1**	**N-A5-C2**	**N-A5-C3**	**Average**	**N-A5-H1**	**N-A5-H2**	**N-A5-H3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-2-METHYLBENZENE	0.7	0.7	0.2	0.5	ND	ND	ND	ND
1,2,3,4-TETRAMETHYLBENZENE	0.3	0.5	0.6	0.4	0.2	0.2	ND	0.2
N-PENT-BENZENE	0.7	0.7	0.4	0.6	ND	0.2	0.4	0.2
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	0.6	0.5	0.7	0.6	1.0	0.6	0.8	0.8
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	ND	ND	ND	ND	ND	ND	ND	ND
FORMALDEHYDE	42.1	44.1	42.1	42.7	25.8	26.8	25.3	25.9
ACETALDEHYDE	14.4	14.6	14.3	14.4	7.8	7.8	7.5	7.7
ACROLEIN	7.9	7.3	7.7	7.6	4.9	4.6	4.8	4.8
ACETONE	4.8	6.0	5.2	5.3	2.9	3.6	2.9	3.1
PROPIONALDEHYDE	1.9	2.7	2.7	2.4	1.0	1.2	1.2	1.2
CROTONALDEHYDE	1.0	1.7	1.4	1.4	0.5	1.0	0.8	0.8
n-BUTYRALDEHYDE, NOTE H	1.2	1.9	1.8	1.6	0.5	0.7	0.7	0.6
METHYL ETHYL KETONE, NOTE H	0.7	0.9	1.0	0.9	0.3	0.4	0.4	0.4
BENZALDEHYDE	5.2	6.3	5.1	5.5	3.7	4.5	3.5	3.9
ISOVALERALDEHYDE	ND	0.1	0.1	0.1	ND	0.1	0.1	0.1
VALERALDEHYDE	0.3	0.4	0.5	0.4	ND	0.5	0.5	0.3
O-TOLUALDEHYDE	ND	ND	ND	ND	ND	0.1	ND	Trace
M/P-TOLUALDEHYDE	4.6	4.7	4.3	4.5	1.9	3.3	2.8	2.7
HEXANALDEHYDE	ND	0.4	0.3	0.2	ND	0.1	0.1	0.1
DIMETHYLBENZALDEHYDE	0.4	0.4	0.4	0.4	0.2	0.3	0.2	0.2
SUMMED SPECIATED VALUES	**183.7**	**199.4**	**194.3**	**192.5**	**117.6**	**126.7**	**117.4**	**120.6**

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**C-BA-T1**	**C-BA-T2**	**C-BA-T3**	**Average**	**C-A5-T1**	**C-A5-T2**	**C-A5-T3**	**Average**
METHANE	13.0	13.6	18.2	14.9	11.3	10.6	10.0	10.6
ETHANE	0.6	0.7	0.8	0.7	0.7	0.6	0.6	0.6
ETHYLENE	2.8	2.5	2.3	2.5	2.4	2.3	2.1	2.3
PROPANE	Trace	Trace	Trace	Trace	0.2	Trace	0.1	0.1
PROPYLENE	0.7	0.6	0.5	0.6	0.5	0.5	0.5	0.5
ACETYLENE	0.1	ND	ND	Trace	Trace	Trace	Trace	Trace
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
1-BUTENE	0.1	Trace	Trace	0.1	Trace	ND	Trace	Trace
2-METHYLPROPENE (ISOBUTYLENE)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.1	Trace	Trace	Trace	0.1	ND	ND	Trace
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	Trace	ND	ND	Trace	ND	ND	ND	ND
2-METHYLPROPANE (ISOBUTANE)	Trace	ND	Trace	Trace	Trace	Trace	Trace	Trace
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.2	0.2	Trace	0.2	ND	Trace	0.1	Trace
UNIDENTIFIED C5 OLEFINS	Trace	ND	ND	Trace	0.1	0.1	Trace	0.1
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	Trace	0.4	ND	0.1	0.2	ND	ND	0.1
2-METHYL-2-BUTENE	Trace	Trace	ND	Trace	Trace	Trace	Trace	Trace
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTENE	Trace	ND	ND	Trace	ND	ND	ND	ND
4-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLBUTANE	Trace	0.1	Trace	Trace	ND	ND	ND	ND

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	C-BA-T1	C-BA-T2	C-BA-T3	Average	C-A5-T1	C-A5-T2	C-A5-T3	Average
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	Trace	Trace	Trace	Trace	0.1	Trace	Trace	Trace
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	Trace	ND	ND	Trace	ND	Trace	ND	Trace
1-HEXENE	ND	ND	ND	ND	ND	Trace	ND	Trace
HEXANE	Trace	ND	Trace	Trace	0.1	Trace	0.1	0.1
UNIDENTIFIED C6	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.3
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	Trace	Trace	0.1	Trace	0.1	0.2	0.3	0.2
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**C-BA-T1**	**C-BA-T2**	**C-BA-T3**	**Average**	**C-A5-T1**	**C-A5-T2**	**C-A5-T3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	Trace	0.2	Trace	0.1	0.2	ND	0.1	0.1
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	ND	ND	Trace	Trace	Trace	Trace	0.3	0.1
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	ND	ND	0.2	ND	ND	0.1
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	Trace	Trace	Trace	Trace	Trace	0.2	0.2	0.1
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	0.1	ND	ND	Trace
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,3-TRIMETHYLPENTANE	Trace	Trace	Trace	Trace	Trace	ND	ND	Trace
TOLUENE	0.2	Trace	0.1	0.1	0.2	0.1	0.1	0.1
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**C-BA-T1**	**C-BA-T2**	**C-BA-T3**	**Average**	**C-A5-T1**	**C-A5-T2**	**C-A5-T3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	Trace	Trace	Trace	Trace	Trace	Trace	0.3	0.1
UNIDENTIFIED C8	ND	Trace	ND	Trace	ND	ND	0.2	Trace
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	Trace	Trace	Trace	Trace	ND	ND	0.2	Trace
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	C-BA-T1	C-BA-T2	C-BA-T3	Average	C-A5-T1	C-A5-T2	C-A5-T3	Average
o-XYLENE	ND	Trace	ND	Trace	Trace	ND	Trace	Trace
1-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	Trace	Trace	ND	Trace	0.2	0.3	ND	0.2
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	0.5	0.2	Trace	0.2	Trace	Trace	ND	Trace
ISOBUTYLBENZENE, NOTE F	0.5	0.2	Trace	0.2	Trace	Trace	ND	Trace
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	Trace	Trace	ND	Trace	0.4	Trace	Trace	0.1
1,2,3-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-ISOPROPYLBENZENE	ND	0.4	ND	0.1	Trace	0.2	Trace	0.1
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	ND	Trace	ND	Trace	Trace	Trace	ND	Trace
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	0.1	Trace	ND	Trace
1,3-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	0.2	ND	0.1
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNDECANE	0.1	0.1	ND	0.1	0.1	0.3	ND	0.1
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	0.2	ND	Trace
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-5 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITH AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**C-BA-T1**	**C-BA-T2**	**C-BA-T3**	**Average**	**C-A5-T1**	**C-A5-T2**	**C-A5-T3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-2-METHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4-TETRAMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
N-PENT-BENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	0.4	0.5	ND	0.3	0.7	0.5	0.3	0.5
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	0.1	ND	ND	Trace	ND	ND	ND	ND
FORMALDEHYDE	2.4	3.0	2.2	2.6	2.3	2.5	2.4	2.4
ACETALDEHYDE	0.7	0.5	0.3	0.5	0.4	0.4	0.4	0.4
ACROLEIN	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
ACETONE	0.2	0.1	ND	0.1	0.5	0.4	0.3	0.4
PROPIONALDEHYDE	ND	0.1	ND	Trace	ND	ND	ND	ND
CROTONALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
n-BUTYRALDEHYDE, NOTE H	Trace	Trace	0.1	Trace	ND	0.1	0.1	0.1
METHYL ETHYL KETONE, NOTE H	Trace	0.1	ND	Trace	0.1	ND	ND	Trace
BENZALDEHYDE	Trace	Trace	ND	Trace	Trace	Trace	Trace	Trace
ISOVALERALDEHYDE	ND	ND	ND	ND	ND	Trace	Trace	Trace
VALERALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
O-TOLUALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
M/P-TOLUALDEHYDE	ND	ND	ND	ND	Trace	Trace	Trace	Trace
HEXANALDEHYDE	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYLBENZALDEHYDE	ND	ND	ND	ND	Trace	ND	ND	Trace
SUMMED SPECIATED VALUES	**23.57**	**24.24**	**25.25**	**24.4**	**22.62**	**21.09**	**19.19**	**21.0**

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	N-BA-T1	N-BA-T2	N-BA-T3	Average	N-A5-T1	N-A5-T2	N-A5-T3	Average
METHANE	9.3	9.3	11.8	10.1	8.6	8.9	4.6	7.4
ETHANE	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4
ETHYLENE	26.9	26.3	27.4	26.9	26.0	27.6	27.2	26.9
PROPANE	0.2	0.2	Trace	0.1	Trace	Trace	Trace	Trace
PROPYLENE	7.4	7.1	7.4	7.3	7.0	7.6	7.4	7.3
ACETYLENE	8.9	8.6	8.9	8.8	8.7	9.4	9.3	9.1
PROPADIENE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-BUTENE	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
1-BUTENE	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.6
2-METHYLPROPENE (ISOBUTYLENE)	0.8	0.8	0.9	0.8	0.8	0.8	0.9	0.8
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.5	0.5	ND	0.3	0.6	0.5	0.6	0.6
PROPYNE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-BUTADIENE	2.1	2.1	2.2	2.1	2.0	2.2	1.8	2.0
2-METHYLPROPANE (ISOBUTANE)	Trace	0.2	ND	0.1	ND	Trace	0.3	0.1
1-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-1-BUTENE	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3
ETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLBUTANE (ISOPENTANE)	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTYNE	ND	ND	ND	ND	ND	ND	ND	ND
1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.4	0.4	0.7	0.5	0.2	0.5	0.1	0.3
UNIDENTIFIED C5 OLEFINS	ND	ND	0.3	0.1	ND	ND	Trace	Trace
2-METHYL-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-PENTENE	0.4	0.4	0.6	0.5	0.2	Trace	Trace	0.1
3,3-DIMETHYL-1-BUTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-PENTENE	ND	ND	0.4	0.1	ND	ND	0.2	0.1
2-METHYL-2-BUTENE	ND	0.1	ND	Trace	0.2	0.6	0.1	0.3
TERT-BUTANOL	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOPENTADIENE	0.3	0.1	0.2	0.2	0.6	0.3	0.5	0.5
2,2-DIMETHYLBUTANE	0.5	0.6	0.6	0.6	0.4	0.5	0.4	0.5
CYCLOPENTENE	0.4	0.4	0.4	0.4	ND	ND	ND	ND
4-METHYL-1-PENTENE	0.4	0.4	0.5	0.4	0.3	0.2	0.3	0.3
3-METHYL-1-PENTENE	0.3	0.2	0.2	0.2	ND	ND	ND	ND
CYCLOPENTANE	0.3	0.2	0.2	0.2	ND	ND	ND	ND
2,3-DIMETHYLBUTANE	ND	ND	0.1	Trace	0.1	Trace	0.1	0.1

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**N-BA-T1**	**N-BA-T2**	**N-BA-T3**	**Average**	**N-A5-T1**	**N-A5-T2**	**N-A5-T3**	**Average**
MTBE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-TRANS-2-PENTENE	0.6	0.5	0.2	0.5	0.4	0.3	0.4	0.4
3-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PENTENE	0.3	0.2	0.3	0.3	ND	ND	ND	ND
1-HEXENE	0.3	0.2	0.3	0.3	ND	0.3	0.4	0.2
HEXANE	0.2	0.2	0.2	0.2	0.8	0.6	0.6	0.7
UNIDENTIFIED C6	ND	Trace	0.4	0.1	ND	ND	0.1	Trace
TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
DI-ISOPROPYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PENTENE	ND	ND	ND	ND	0.8	0.2	Trace	0.4
3-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOPENTANE, NOTE A	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLBUTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYLCYCLOPENTENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	2.9	2.9	3.0	2.9	2.9	3.1	3.2	3.0
3-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	Trace	ND	Trace
TERT-AMYL METHYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**N-BA-T1**	**N-BA-T2**	**N-BA-T3**	**Average**	**N-A5-T1**	**N-A5-T2**	**N-A5-T3**	**Average**
1-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLPENTANE	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
2-METHYL-1-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANE	ND	Trace	Trace	Trace	ND	Trace	0.1	Trace
CIS-3-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C7	ND	ND	ND	ND	ND	ND	0.1	Trace
2-METHYL-2-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYL-TRANS-3-HEXENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-HEPTENE	Trace	ND	Trace	Trace	0.3	0.2	ND	0.2
3-ETHYL-CIS-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-1-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-HEPTENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,2-DIMETHYLCYCLOPENTANE	Trace	ND	0.3	0.1	Trace	Trace	0.2	0.1
2,2-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4,4-TRIMETHYL-2-PENTENE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,3-TRIMETHYLPENTANE	ND	ND	ND	ND	0.4	0.3	0.4	0.4
2,5-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.2	ND	0.2	0.1	ND	ND	ND	ND
3,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4-TRIMETHYLPENTANE	Trace	ND	0.1	Trace	0.1	0.2	Trace	0.1
2,3,3-TRIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.6	0.5	ND	0.4	0.6	0.8	0.9	0.8
2,3-DIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEXANE, NOTE B	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,4-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
3-ETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**N-BA-T1**	**N-BA-T2**	**N-BA-T3**	**Average**	**N-A5-T1**	**N-A5-T2**	**N-A5-T3**	**Average**
2,2,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3
1,1-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-1-ETHYL-CYCLOPENTANE	0.2	0.2	0.2	0.2	ND	ND	ND	ND
2,4,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
1-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-4-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	Trace	ND	Trace	Trace	Trace	0.2	0.2	0.1
UNIDENTIFIED C8	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	ND	ND	ND	ND	ND	ND	ND	ND
CIS-2-OCTENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3,5-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DIMETHYLHEPTANE	Trace	Trace	Trace	Trace	Trace	0.1	Trace	Trace
CIS-1,2-DIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLCYCLOHEXANE	Trace	Trace	0.2	0.1	ND	Trace	0.3	0.1
2,6-DIMETHYLHEPTANE, NOTE D	ND	ND	ND	ND	ND	ND	ND	ND
1,1,3-TRIMETHYLCYCLOHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
3,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,5-DIMETHYLHEPTANE, NOTE E	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	0.5	0.3	0.4	0.4	0.3	0.4	0.4	0.4
2,3,4-TRIMETHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
m-& p-XYLENE	0.9	ND	ND	0.3	0.9	0.9	0.6	0.8
4-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
3,4-DIMETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
4-ETHYLHEPTANE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLOCTANE	Trace	ND	Trace	Trace	0.4	0.4	0.2	0.3
3-METHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	0.2	0.4	0.4	0.3	0.1	0.1	ND	0.1

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**N-BA-T1**	**N-BA-T2**	**N-BA-T3**	**Average**	**N-A5-T1**	**N-A5-T2**	**N-A5-T3**	**Average**
o-XYLENE	0.4	0.4	0.4	0.4	0.2	0.4	0.2	0.3
1-NONENE	Trace	Trace	0.1	0.1	0.1	Trace	0.3	0.1
TRANS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-3-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
NONANE	0.4	0.3	0.3	0.3	0.2	0.7	0.3	0.4
TRANS-2-NONENE	ND	ND	ND	ND	ND	ND	ND	ND
ISOPROPYLBENZENE (CUMENE)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DIMETHYLOCTANE	ND	ND	ND	ND	ND	ND	ND	ND
n-PROPYLBENZENE	Trace	Trace	Trace	Trace	0.1	0.1	0.2	0.1
1-METHYL-3-ETHYLBENZENE	Trace	0.1	0.1	0.1	0.2	0.1	0.3	0.2
1-METHYL-4-ETHYLBENZENE	ND	Trace	Trace	Trace	ND	ND	0.3	0.1
1,3,5-TRIMETHYLBENZENE	0.4	0.3	0.6	0.4	ND	ND	ND	ND
1-METHYL-2-ETHYLBENZENE	ND	ND	0.3	0.1	0.3	ND	ND	0.1
1,2,4-TRIMETHYLBENZENE	0.7	0.6	0.6	0.6	0.6	0.6	0.9	0.7
TERT-BUTYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-DECENE	ND	ND	ND	ND	ND	ND	ND	ND
DECANE, NOTE F	0.1	0.1	0.4	0.2	0.1	0.2	Trace	0.1
ISOBUTYLBENZENE, NOTE F	0.1	0.1	0.4	0.2	0.1	0.1	Trace	0.1
1,3,-DIMETHYL-5-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
METHYLPROPYLBENZENE (sec butylbenzene)	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-ISOPROPYLBENZENE	0.1	Trace	0.1	0.1	0.2	0.4	0.2	0.3
1,2,3-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	0.2	0.1
1-METHYL-4-ISOPROPYLBENZENE	0.3	0.2	0.3	0.3	0.2	0.2	Trace	0.1
INDAN	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-ISOPROPYLBENZENE	Trace	0.2	0.3	0.2	ND	ND	0.2	0.1
1,3-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-3-N-PROPYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.3
1,2 DIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1-METHYL-2-N-PROPYLBENZENE	Trace	ND	0.2	0.1	ND	ND	ND	ND
1,4-DIMETHYL-2-ETHYLBENZENE	ND	0.6	Trace	0.2	ND	ND	ND	ND
1,3-DIMETHYL-4-ETHYLBENZENE	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.4
1,2-DIMETHYL-4-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIMETHYL-2-ETHYLBENZENE	0.2	Trace	ND	0.1	0.2	0.2	0.2	0.2
UNDECANE	0.5	0.6	0.7	0.6	0.8	0.7	0.8	0.8
1,2-DIMETHYL-3-ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-TETRAMETHYLBENZENE	Trace	Trace	0.2	0.1	Trace	Trace	Trace	Trace
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4

TABLE B-6 (CONT'D). COMPARISON OF COMPOSITE HYDROCARBON SPECIATION DATA WITHOUT AFTERTREATMENT (BACKGROUND CORRECTED)

	Composite, mg/bhp-hr				Composite, mg/bhp-hr			
COMPOUND	**N-BA-T1**	**N-BA-T2**	**N-BA-T3**	**Average**	**N-A5-T1**	**N-A5-T2**	**N-A5-T3**	**Average**
3,4 DIMETHYLCUMENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,5-TETRAMETHYLBENZENE	0.2	0.3	0.3	0.3	ND	ND	ND	ND
TERT-1-BUT-2-METHYLBENZENE	0.3	0.4	0.1	0.3	0.1	0.1	Trace	0.1
1,2,3,4-TETRAMETHYLBENZENE	0.2	0.4	0.4	0.3	0.2	0.3	0.1	0.2
N-PENT-BENZENE	0.3	0.3	0.3	0.3	0.1	0.3	0.4	0.3
TERT-1-BUT-3,5-DIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
TERT-1-BUTYL-4-ETHYLBENZENE	ND	0.3	0.5	0.3	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
DODECANE	0.3	0.7	1.3	0.8	0.9	0.6	0.8	0.8
1,3,5-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
UNIDENTIFIED C9-C12+	ND	ND	0.1	Trace	ND	ND	ND	ND
FORMALDEHYDE	27.8	28.1	29.4	28.5	28.1	29.2	27.7	28.3
ACETALDEHYDE	8.6	8.9	9.0	8.8	8.7	8.7	8.4	8.6
ACROLEIN	4.6	5.3	5.3	5.1	5.3	5.0	5.2	5.2
ACETONE	3.4	3.7	3.5	3.5	3.2	4.0	3.2	3.5
PROPIONALDEHYDE	1.2	0.4	1.2	0.9	1.2	1.4	1.4	1.3
CROTONALDEHYDE	0.9	0.9	0.6	0.8	0.6	1.1	0.9	0.8
n-BUTYRALDEHYDE, NOTE H	0.9	0.9	0.5	0.7	0.6	0.9	0.9	0.8
METHYL ETHYL KETONE, NOTE H	0.6	0.6	0.2	0.4	0.3	0.5	0.5	0.4
BENZALDEHYDE	3.3	3.5	4.1	3.6	3.9	4.7	3.7	4.1
ISOVALERALDEHYDE	0.1	Trace	0.3	0.2	ND	0.1	0.1	0.1
VALERALDEHYDE	0.7	0.5	0.7	0.6	Trace	0.5	0.5	0.4
O-TOLUALDEHYDE	2.3	2.3	2.9	2.5	ND	0.1	ND	Trace
M/P-TOLUALDEHYDE	0.9	0.8	1.1	1.0	2.3	3.5	3.1	2.9
HEXANALDEHYDE	Trace	0.2	0.1	0.1	ND	0.2	0.1	0.1
DIMETHYLBENZALDEHYDE	0.3	0.4	0.9	0.5	0.2	0.3	0.3	0.3
SUMMED SPECIATED VALUES	**131.1**	**130.2**	**142.1**	**134.5**	**127.0**	**137.1**	**128.4**	**130.8**

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.
B - 3-Methyl-3-ethyl-pentane co-elutes with reported compound. Not reported separately.
C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.
D - Propylcyclopentane co-elutes with reported compound. Not reported separately.
E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area split equally between the two compounds.
F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.